PHYSICAL GEOGRAPHY DEPT.

Construction Methods

Graw-Hill Publishing Company, Inc.

January, 1936

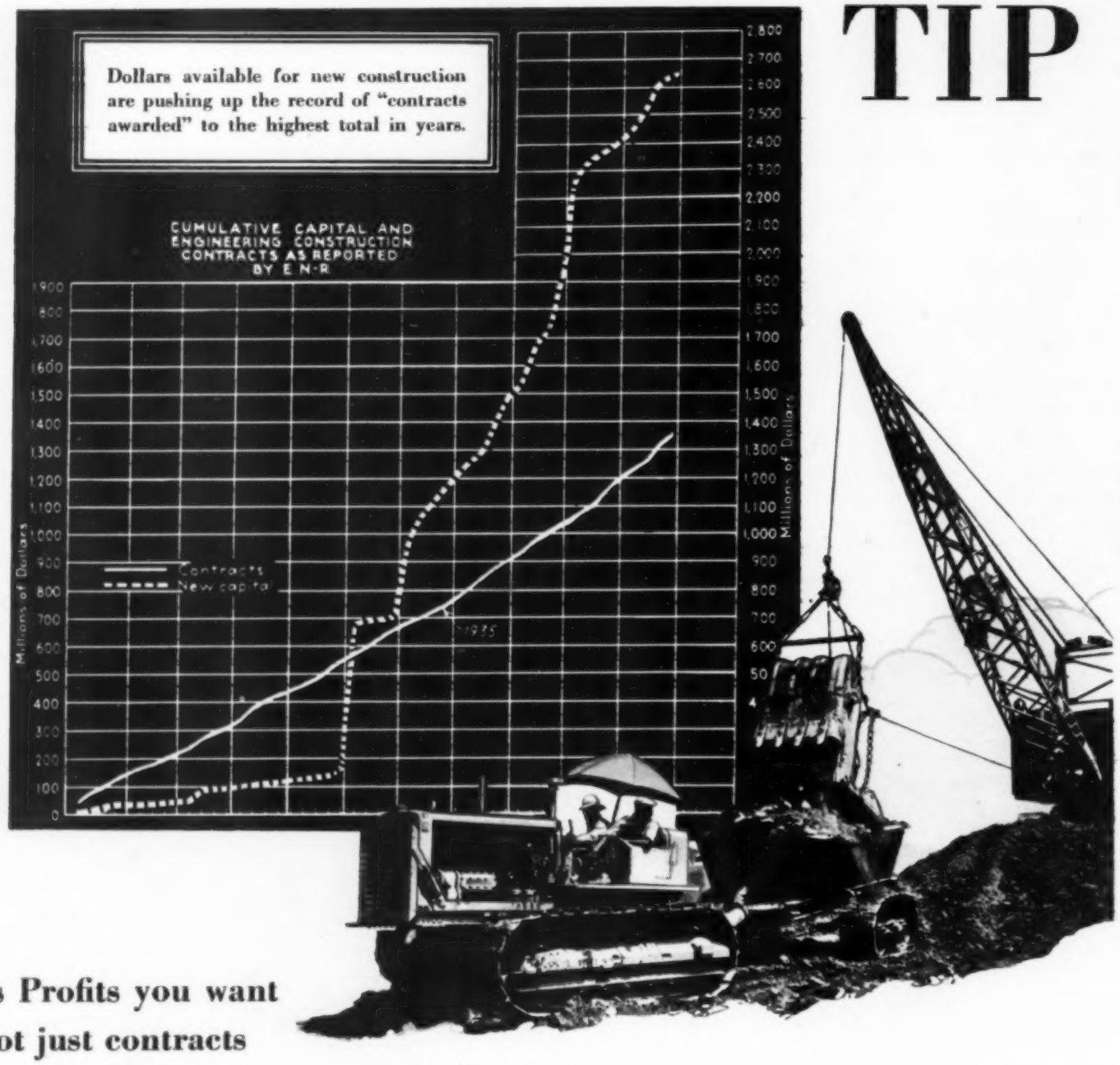
Price 20 Cents

ROAD BUILDERS' NUMBER

MAINTENANCE OF WINTER TRAFFIC on U. S. Highway No. 40 through the Sierras, in Placer County, requires regular snow removal by crews of Division of Highways, California Department of Public Works.

1 R v.18 1936

A Cold Chart gives a HOT TIP


Dollars available for new construction are pushing up the record of "contracts awarded" to the highest total in years.
CUMULATIVE CAPITAL AND ENGINEERING CONSTRUCTION CONTRACTS AS REPORTED BY E N-R
Millions of Dollars
Contracts
New capital
1935

But it's Profits you want ... not just contracts

The above chart gives promise of new contracts in 1936.

But the profits on your contracts depend largely on how well your equipment stands the gaff—day in, day out.

Your Diesels especially. To keep them running at top form requires a superior type of oil—one that is low in carbon, gums, and sludge-forming elements.

You get exactly such an oil in Texaco Ursa. The very small amount of carbon left by Texaco Ursa Oils is of a dry, fluffy nature. It does not build up in the engine but is blown out through the exhaust ports.

Besides keeping your Diesels at top-notch performance, Texaco Ursa Oils will extend their life, and cut down overhauls. Naturally they lower repair costs.

Write to The Texas Company and we will send our representative to serve you. He will provide the lubricants best fitted for each piece of equipment.

THE TEXAS COMPANY, 135 E. 42nd St., N. Y. C.
Nation-wide distribution facilities assure prompt delivery

IN SERVICE TO INDUSTRY

All important Diesel manufacturers approve Texaco Ursa Oils for the lubrication of the equipment they make.

TEXACO *Industrial Lubricants*

TECHNOLOGY DEPT.

Construction Methods

McGraw-Hill Publishing Company, Inc.,
330 West 42nd St., New York

ROBERT K. TOMLIN, Editor

JANUARY, 1936

WILLARD CHEVALIER, Vice-President

Editorial Staff: Vincent B. Smith, John B. Huttl, (San Francisco)
Leonard H. Church (Cleveland), Nelle Fitzgerald

CONSTRUCTION METHODS was founded in 1919, under the name of *Successful Methods*, by the Manufacturers Publicity Bureau, Inc., of Chicago, representing a group of non-competing manufacturers of construction equipment. Charles R. Thomas, editor of the first few issues, was succeeded by William Jabine.

In 1926 the McGraw-Hill Publishing Company, Inc., of New York, purchased the publication, changing its name to *Successful Construction Methods* in November of that year and to *Construction Methods* in May, 1927, in order more accurately to define its field and purpose.

All rights to the foregoing titles are reserved by the publisher.

Robert K. Tomlin was appointed editor of *Construction Methods* in January, 1928. Vincent B. Smith is associate editor, John B. Huttl (San Francisco) Pacific Coast editor, Leonard H. Church (Cleveland) assistant editor and Nelle Fitzgerald, editorial assistant.

Annual Road Builders' Number

● Once again, this month, the annual Road Builders' Number of *Construction Methods* makes its bow on the eve of the convention and "old-fashioned" Road Show of the American Road Builders' Association. Within the limits of space available it is possible to deal with only a few of the many interesting applications of methods, equipment and materials that have marked the 1935 highway program. Hampered by restrictions on allowable hours of work and the necessity of carrying on with organizations recruited largely from relief rolls, road building has, nevertheless, continued its march forward.

From last year's projects a selection has been made to cover representative types of construction and to indicate in text and illustration those details of field practice which every construction man recognizes as so important in determining the success of the job. In the pages that follow the subjects treated include bituminous, cement concrete, brick and earth road construction, together with notes on the timely topics of winter methods for building highway bridges, main-line relocation and grade separation. From the point of view of novelty and the ingenious application of method and equipment the outstanding project described is one on which a trunk-line concrete highway in New Jersey was widened and provided with a central traffic-separating "island" by pneumatic jacking — shoving the slabs apart with long lines of rubber hose alternately inflated with compressed air and deflated.

Engineers in state highway service, who have been called upon to provide jobs in wholesale lots for the unemployed, should find something of interest in the recital of Minnesota's experience in assigning thousands of relief workers to a 2,000,000-cu.yd. grading project for a belt-line route. One feature of the effort to develop some vestige of efficiency in the organization of the inexperienced, heterogeneous personnel is significant: After strictly hand-labor methods had been supplemented by the introduction of a small amount of power-driven excavating and haulage equipment there was a noticeable pickup in the morale of the workers and a marked increase in their output due to the realization that with machinery at work alongside them they were part of a real construction job instead of some time-wasting, boondoggling project on which it mattered little whether they worked or loafed.

This issue of *Construction Methods* will have accomplished its purpose if it suggests some ways in which the road builder may improve the quality of his product or revise the technique of his field practice to take advantage, in lower production costs and increased output, of the improvements and refinements in the mechanical equipment now available for his use.

Talburt, in Scripps-Howard Newspapers

The Road Hog!

Bituminous Pavement Progress

● Recent years have witnessed steady development of mechanical aids for the production of bituminous pavement approaching absolute uniformity in composition, texture and surface smoothness. Working hand-in-hand with this improvement in construction procedure, designing and testing engineers have made noteworthy progress in refining their technique for control and comparison of bituminous mixtures. Both at the mixing plant and on the road improvements in field methods are evident, as may be judged from two articles in this issue describing projects in Michigan and Wisconsin. Automatic apparatus to facilitate control of mixing time and temperatures, accurate measuring equipment for weight-proportioning of materials, and reliable machines to spread and strike off the bituminous mixtures are outstanding indicators of a broad movement toward ever higher standards in bituminous pavement construction.

Better Roads at Lower Cost

● For the last few years road builders have cooperated willingly in the effort to spread employment by modifying their construction practices to use the labor of more men. A great national emergency justified the temporary concessions and won the active cooperation of highway engineers and contractors in putting additional men from relief rolls to work at every point where human labor could be utilized with reasonable economy. Necessary though these expedients may be in a period of wide unemployment, it must be remembered that they do retard the normal improvement in methods of highway construction. Now, with evidence of growing business volume on every hand, road builders are looking forward to the day when all temporary regulations that limit the efficiency of construction may be removed.

Winter Concrete

● Concrete construction in cold weather continues to make steady progress. Through a period of ten years, the State Highway Commission of Wisconsin has applied and refined a technique of winter construction which effectively repels the attacks of freezing temperatures on bridge projects in the state; an article in this issue recounts the methods. In the concrete paving field, the Ohio Department of Highways this winter has stepped forward with a number of projects planned for uninterrupted construction through the cold months. Previous experience of the department has demonstrated the practicability of paving at low temperatures. The examples of these two states may be a favorable omen of the day when highway departments in the northern states will maintain an unbroken concrete construction program through the twelve months of the year.

Stabilized Base Construction

● Tested and proved by several years' experience, the stabilized claybound soil oad incorporating a deliquescent chemical salt to preserve the binding quality of the clay has become an accepted type of construction in those states and communities which have given it a trial. Low in first cost and economical to maintain, the stabilized road recommends itself as a serviceable track in all kinds of weather for light to moderate traffic volumes. As a further advantage it makes a sound base for later surfacing. Where early paving is desired, as is the case on the Indiana project described elsewhere in these pages, the stabilized construction performs a dual service by shortening the period of base consolidation and by carrying traffic smoothly and safely during the interval preceding final surfacing.

Chapter III on **Heavy Construction** *Next Month*

Because of the publication this month of the annual Road Builders' Number of *Construction Methods* it has been necessary to postpone until the February issue Chapter III in the series of articles on "Planning and Plant for Heavy Construction," by A. J. Ackerman and Charles H. Locher. Chapter III, next month, will continue the discussion of construction camp layout, shop buildings and utilities.—Editor.

The Highway Industry *Looks Ahead*

THE widespread interest in the forthcoming convention and road show of the American Road Builders Association is welcome evidence of a renewed vigor in the field of highway improvement. After having been suspended for two years, the road show has been so heavily oversubscribed as to necessitate a material expansion of the exhibit area; in many cases exhibitors have returned to request larger spaces than they had at first reserved. Hotel registrations indicate an attendance several times larger than that of the 1933 convention. On every count the outlook is for a substantial revival of the old aggressive spirit in the road-building industry.

All this signifies more than just a successful convention of a national association. It reflects very definitely the confidence and well-being of an industry that ramifies through many departments of American business and affects the employment and prospects of workers and employers in many lines of work. Road building is not merely a department of public administration; it is an essential function of the vast and basic industry of motor transportation. It is not merely an outlet for the taxpayers' money; it is one of our most productive investments in public wealth, ranking easily with the development of modern water-supply and sanitation. It is not merely a public utility designed to supplant private enterprise; it is the generator of a new group of private industries and callings that provide jobs for one-tenth of those normally employed. Highway improvement is one of the most productive investments ever made by the American people in terms of social progress, industrial expansion and trade stimulation; among such investments it is distinctive as a breeder and a servant of private enterprise.

ON the eve of the Cleveland convention it is worth while to recall these fundamental facts and to remind ourselves that the road ahead of highway improvement is beset with many problems. During the next few years these will call for resourceful and aggressive effort.

Already those who favor radical retrenchment in public spending are lining up for a battle that may pay little heed to the just claims of any form of public expenditure. Every business man, whether affiliated with the road-building industries or not, will agree that it is necessary to economize to the maximum in the administrative expenses of government. They know how necessary it is, not alone because of the taxes that must be levied to meet them but also because of the peril that lies in the indefinite continuation of a public trough to feed a horde of superfluous office holders and dependents.

But what many business men outside the highway industry do not seem to recognize is the danger of starving constructive and productive public investment while special revenues collected for that purpose are diverted into the very extravagances that they deplore. It does not help simply to slash the total costs of government if we retain the extravagances and eliminate functions that do, in fact, contribute to the public wealth and to the nourishment of private business.

THE industry now assembling at Cleveland must consider also the present agitation for greater highway safety, which points to the necessity of keeping our highway plant abreast of the needs of modern traffic. The wholesale diversion of highway revenues to general uses takes its toll of projects that make for safer highways as well as those required for normal extension and improvement.

Many other problems confront the industry. As they gather for their convention, the officials and engineers responsible for planning and administering the highways, the contractors who must build them, the manufacturers and distributors who provide the equipment and materials of construction and who constitute so important a segment of private industry, all should see clearly the need for unified effort, not alone in their own interest but also to perform their special function in behalf of the general welfare. Only from such unified effort can emerge a highway policy that will take into account the public need for adequate and safer motor transport, the most economical measures by which to meet that need and a rational distribution of the costs amongst the several beneficiaries.

The formulation of such a policy and of means by which to keep before the public the real significance of American highway development constitutes a task worthy of the best the industry has to offer.

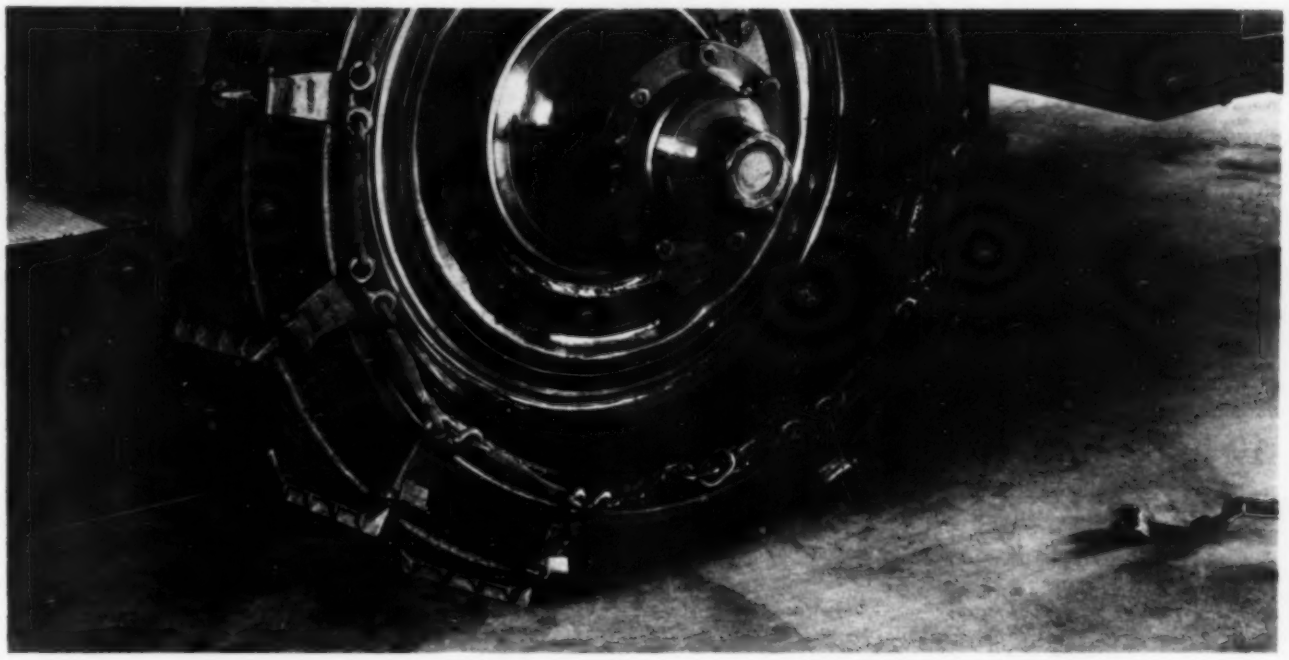
Willard Chevalier

CONSTRUCTION METHODS. January, 1936. Volume 18, Number 1. Published Monthly, price 20¢ a copy. Subscription rates—United States, Canada, Mexico, and Central and South American countries, $2.00 a year. All other countries, $4.00 a year or 16 shillings. Entered as second class matter October, 1926, at Post Office at New York, N. Y., under the act of March 3rd, 1879. Printed in U.S.A. Cable address "McGrawhill, New York." Member of A.B.P. Member of A.B.C. Contents Copyrighted 1936 by McGraw-Hill Publishing Co. Inc., 330 West 42nd Street, New York, N. Y.

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

Editorial and Publishing Offices: 330 West 42d St., New York; 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, W. C. 2, England. Branch Offices: Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta, Ga.

JAMES H. McGRAW, JR. Chairman
WILLARD CHEVALIER Vice-President
MALCOLM MUIR President
B. R. PUTNAM Treasurer
JAMES H. McGRAW Honorary Chairman
D. C. McGRAW Secretary



Let 'Em Bite!

'INCOR' CAN TAKE IT

TRAFFIC moves fast at Eastern Massachusetts Street Railway Company's motor-coach garage, Lynn, Mass. Ten-ton buses start and stop suddenly, back up, swing quickly into parking stalls. Bad enough in Summer, the punishment these floors take in Winter is plenty. Sparks fly when chisel-sharp tire-chain links grind on the 'Incor' concrete floor. But let 'em bite—'Incor' can take it!

'Incor' was used to obtain strong, dense, watertight concrete and complete the garage before cold weather set in. Two weeks were saved—freezing risk eliminated and garage in use that much sooner. Reason: 'Incor' combines with water 5 times as fast as ordinary cement. Result, service strengths in 24 hours, watertight curing in 48 hours instead of 10 days. Thorough curing in fraction of usual time is soundest assurance of obtaining stronger, more durable concrete—the kind that stands the gaff.

Write for illustrated book "Heavy Duty Floors." Tells how busy floors are resurfaced over a week-end. Also a timely book on "Winter Construction." Address 'Incor'* Cement' Room 2200, 342 Madison Ave., New York. Made and sold by producers of Lone Star Cement, subsidiaries of International Cement Corporation, New York; also sold by other leading cement manufacturers.

*Reg. U. S. Pat. Off.

'INCOR' 24-Hour Cement

ON THE NATION'S Biggest Jobs

TRAC-TRUKS Excel IN PRINCIPLE AND PERFORMANCE

Fort Peck..

A mammoth project where twenty-two Trac-Truks distinguished themselves under any condition in all kinds of weather.

Sutherland Dam..

Where eighteen Bottom Dump Trac-Truks attracted the attention of and influenced contractors to come long distances to witness their operation.

Ohio Dams..

Literally scores of Trac-Truks were sold for the Muskingum Conservancy Work and easily became the outstanding development of the year in hauling equipment operation.

T.V.A..

With the initial order developing into repeat business of an additional fleet, this project may be listed as an important one in the history of Trac-Truk purchases.

Enfield Dam..

Trac-Truk operation in New England is aptly exemplified in the use at Enfield, where thirteen of these units have been at work since early in 1935.

Mississippi Levee..

Levee contractors working to harness "Old Man River" have purchased fleet after fleet of Trac-Truks which have established enviable records in piling up the mountains of earth embankment.

Sullivan Dam..

This dam construction in the Rocky Mountain area afforded an opportunity to use eight Trac-Truks which really were all set in the mind of the contractor before the bid was even placed.

Clear Creek Reservoir..

This project near Fort Smith, Arkansas, involves more than a million yards being moved wtth eight stalwart Rear Dump Trac-Truks.

Atlantic-Gulf Canal..

Barely had this tremendous work been launched before Trac-Truks moved in, which was to be expected with the millions of yards to be moved.

EUCLID
THE PIONEER

SEE TRAC-TRUKS
AT THE ROAD SHOW SPACE C-27

FOREMOST IN ENGINEERING DEVELOPMENT

THEY HAUL LARGER PAYLOADS *Faster-Cheaper*

TRAC-TRUKS accomplish their extraordinary results by a faster and better way. These sensational machines secure higher pay production and make job costs less, in moving dirt cheaper, *by equal efficiency for every operation in the hauling cycle.* Their advantages begin with bigger payloads in comparison to gross weight. Their *travel speed* is described as comparable with the fastest of heavy hauling equipment. The big broad tires provide the *greatest advance in traction*—flotation of heavy loads and better rolling action. In *dumping time,* their performance is a revelation in real accomplishment. These and many other exclusive facilities in Trac-Trucks account for their extensive use in the building of great public works and creating of good will with satisfying service.

THE EUCLID ROAD MACHINERY CO.
CLEVELAND, OHIO U. S. A.

GROUND
make their
any weather

PROGRESSIVE operators, whether the jo
is big or small, know that Firestone Ground Gr
Tires give them the super-traction they need
save wear and tear on their equipment, an
speed up the work. In addition to their use o
buggies, road graders and other earth workin
equipment they are finding wide use o
contractors' trucks and cars, where they mu
get through regardless of road or weather.

Firestone patented construction features a
responsible for the amazing succe
of the new Firestone Ground Gr
Tire. It is ea
to see wh
the massiv
tread, with
scientifical
designed an

DGRIP TIRES

r own road . . . in r . . . anywhere!

widely spaced bars of tougher rubber, gives you super-traction, and is self-cleaning. Of equal importance is the fact that the body of this tire is built with Gum-Dipped high stretch cords, giving the tire great strength to withstand the terrific stresses and strains of heavy pulling with low air pressure. In addition, there are two extra layers of Gum-Dipped cords under the tread, locking it inseparably to the cord body. These are patented Firestone construction features used in no other tire.

Equip now with Firestone Ground Grip Tires—they will save time and money for you on every job. When ordering new equipment be sure to specify Firestone Ground Grip Tires — the greatest traction tires ever built.

• • •

Listen to the Voice of Firestone featuring Richard Crooks or Nelson Eddy — with Margaret Speaks, Monday evenings over Nationwide N. B. C.—WEAF Network

© 1936, F. T. & R. Co.

Firestone

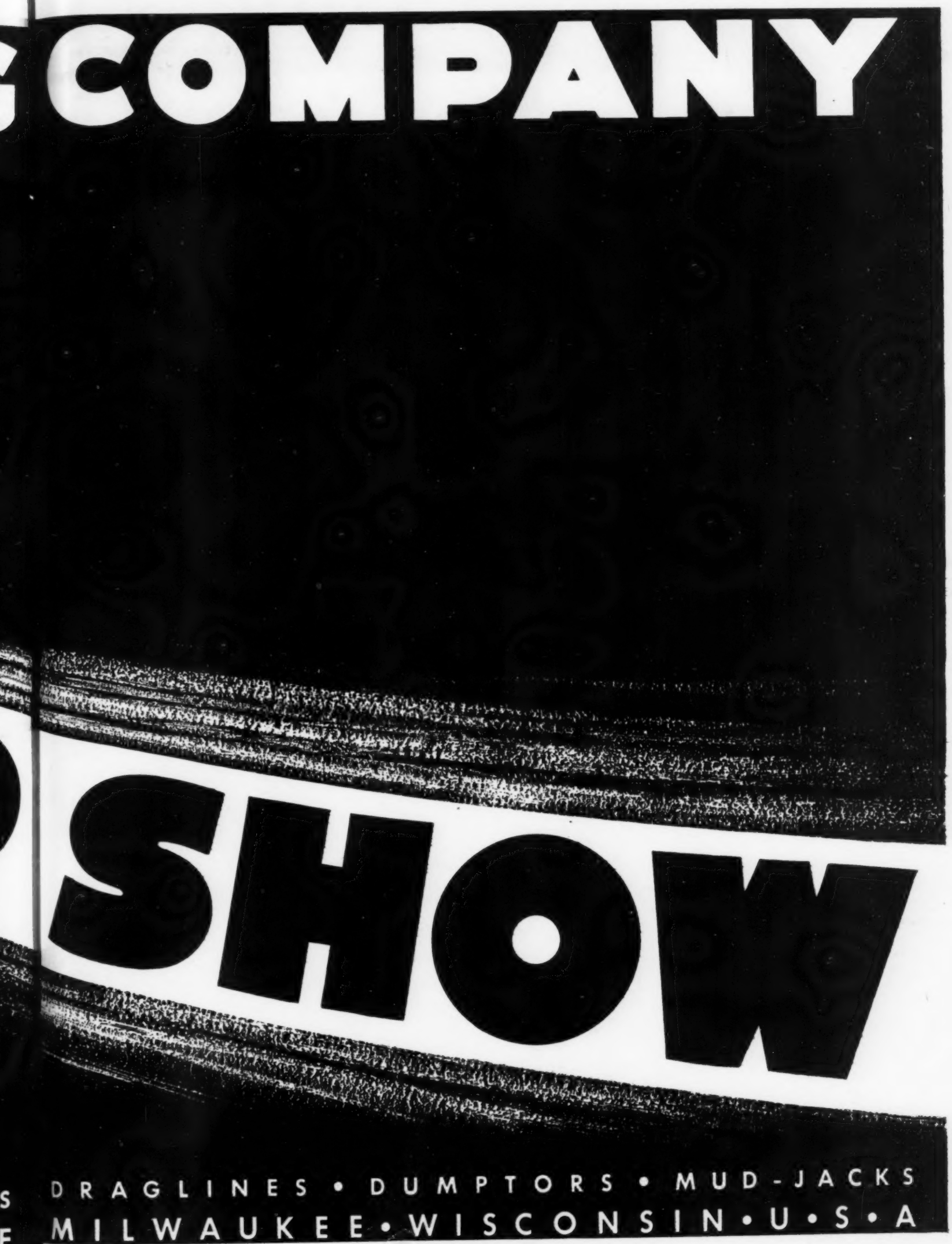
KOEHRING

AT THE ROAD

KOEHRING HEAVY DUTY

PAVERS • MIXERS • SHOVELS • CRANES

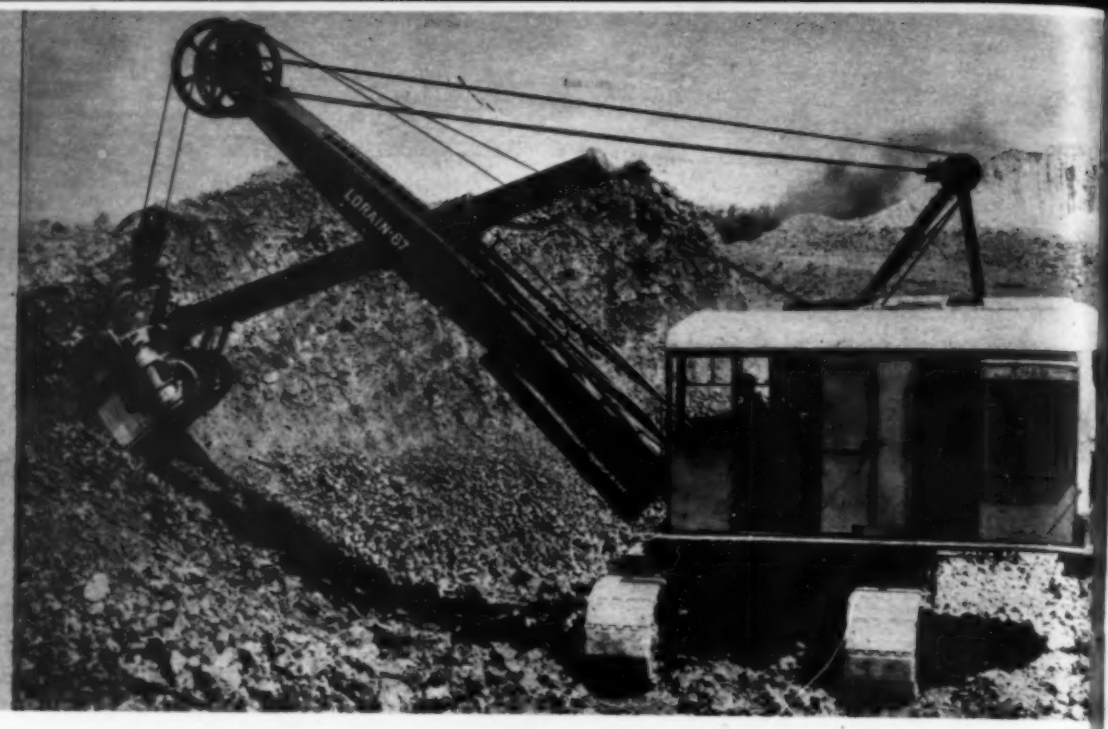
3026 WEST CONCORDIA AVENUE


COMPANY
SHOW
DRAGLINES • DUMPTORS • MUD-JACKS
MILWAUKEE • WISCONSIN • U • S • A

THEW *and* UNIVERSAL

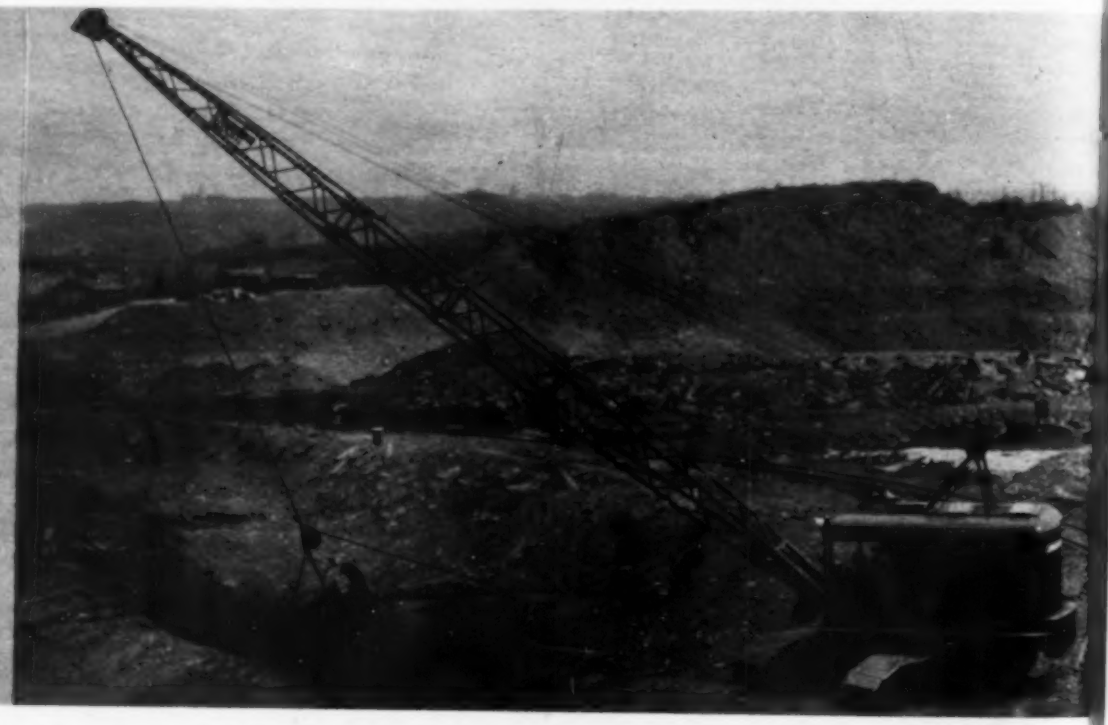
2-YARD LORAIN-87

New from crawler treads to boom tip—a Center Drive, convertible unit with the newest development in shovel booms since the shipper shaft boom.



BIG DRAG LINE LORAIN-95

Specially designed—and Center Drive built—for big capacity, long range, dragline, clamshell or crane service—mounted on a crawler 18 ft. long.



1-YARD LORAIN-55D

A heavy-duty 1-yd. shovel—full 15-ton crane capacity—with longer shovel boom; bigger, heavier crawler; Diesel powered for increased output at lower fuel cost.

L *present* 5 NEW LORAINS ★

★ In presenting these five new Lorains for 1936, Thew and Universal express their confidence in the future of the Construction Industry.

In building these five new Lorains to the tried, tested and proved Center Drive design—and in refining and greatly improving all Lorain models—Thew and Universal again express their confidence in the continued ability of all Center Drive units to move more dirt, faster and at lower costs . . . a fact well proved by Lorain field performance.

5 New Models . . plus these other improved LORAINS

LORAIN · 77
1½-yd. shovel—20-ton crane—Diesel powered

LORAIN · 75D
1¼-yd. shovel—18-ton crane—Diesel powered

LORAIN · 45
Heavy-duty ¾-yd. shovel—Diesel powered

LORAIN · 40
¾-yd. Capacity, Strength, Power; ½-yd. Weight

LORAIN · 37
⅝-yd. Shovel, Crane, Clam, Drag

LORAIN · 30
½-yd. Shovel—with special trailer

THE THEW SHOVEL CO., LORAIN, O.
THE UNIVERSAL CRANE CO., LORAIN, O.

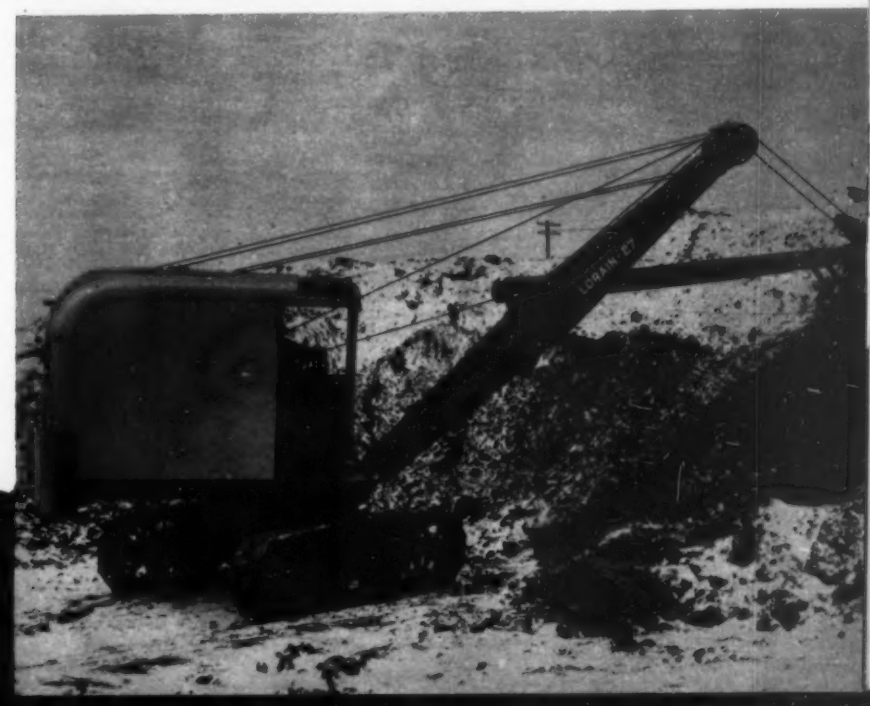
THEW CENTER DRIVE

¾-YARD LORAIN-40 Truck Shovel

L-40 minimum weight and balanced design now permits offering you ¾-yd. shovel output and earnings combined with motor truck high speed mobility.

⅜-YARD LORAIN-2

A ⅜-yd. full-revol ing unit, built to standard of quali equal to or bett than that of any e cavator, regardle of size or pric Also special traile



A century has passed since Wm. Bickford discovered that a simple twist of jute yarn could be made to hold a core of gun powder in a continuous, slow-burning train.

In this discovery he bridged a hundred years — perhaps an age, for during the century that has witnessed the greatest progress the world has ever known, this basic principle has remained unchanged.

Bickford Safety Fuse came to America in 1836. At first a crude, handmade product, its development throughout the years has been evidenced by closer standards, better materials, finer construction. Steady improvement rather than radical change bears witness to able thinking, careful planning one hundred years ago.

In 1936 we celebrate our Centennial — and dedicate ourselves to maintain these high standards, that Ensign-Bickford Safety Fuse may ever be dependable.

A product, like a person, is known by the company it keeps. During this year we shall show you the use of Ensign-Bickford Safety Fuse and Cordeau-Bickford Detonating Fuse by famous companies.

SF50

ENSIGN-
BICKFORD
Safety Fuse
Since 1836
CORDEAU-
BICKFORD
Detonating Fuse

Simsbury, Connecticut, U. S. A

The
ENSIGN-BICKFORD COMPANY

ROAD BUILDERS--SEND for YOUR COPY

(56-Page Pictorial Review of Modern Road Building Shows Latest Type Methods and Machines in Use Today)

We Reproduce This Index Page to Show Contents

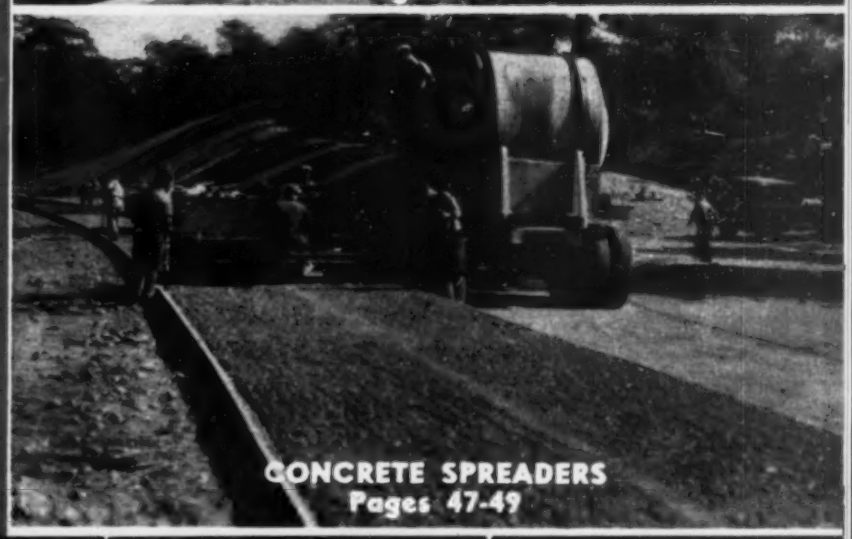
BITUMINOUS PAVERS
Pages 3-14

CONCRETE FINISHERS
Pages 15-28

STABILIZED or RETREAD
Pages 35-42

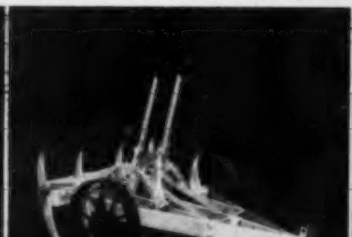
COMBINATION FINISHER and SPREADER
Pages 30-31

MACADAM - BITUMINOUS SPREADER BOXES
Pages 43-46



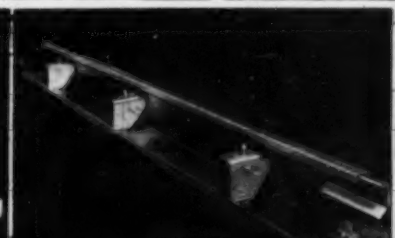
CONCRETE SPREADERS
Pages 47-49

ROAD PUMPS
Page 55

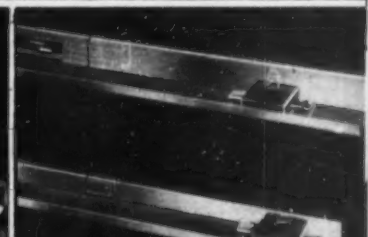


GRADE ROOTER
Page 51

SUBGRADER
rage 50



CONCRETE



ASPHALT

STEEL ROAD FORMS
Pages 52-54

MIXERS

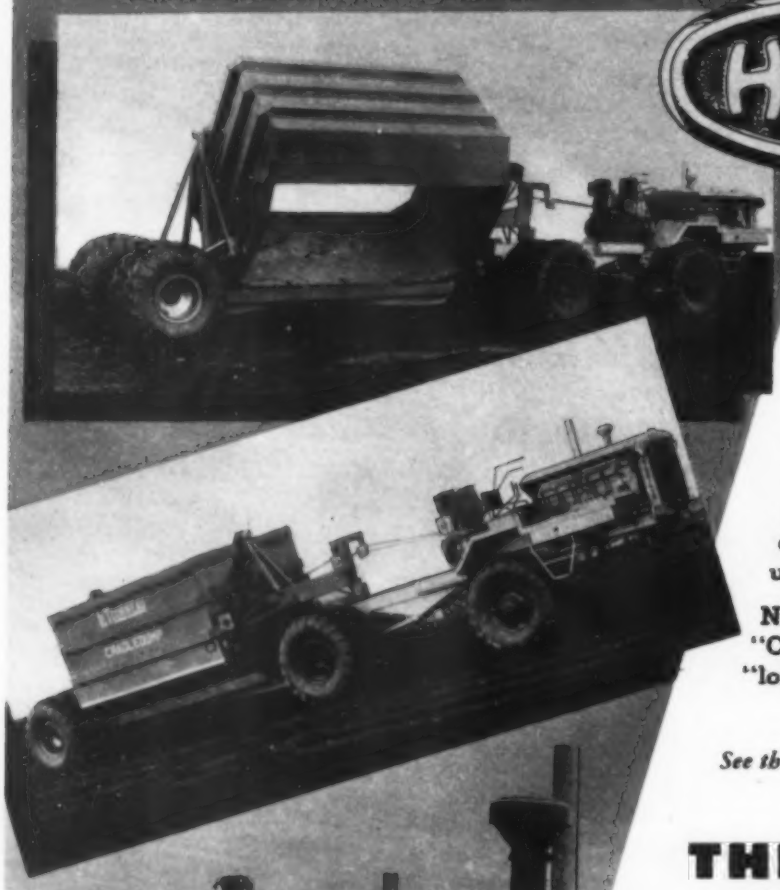
PUMPS

A Post Card Brings You Your Copy

THE JAEGER MACHINE CO.

800 DUBLIN AVENUE, COLUMBUS, OHIO

BIG NEWS, FOR DIRT MOVERS!



HUG

Roadbuilders and contractors handling large dirt-moving projects will find the answer to their dirt-moving problems in the amazing new Hug dirt-moving Tractor Truck.

Think of it! The new Hug Tractor Truck powered with a "Caterpillar" Diesel Engine—front and rear wheel drive axles — mounted on six 18-in. x 24-in. tires — 12 speeds forward transmission, capable of moving 30 yards of dirt, rock or stone at one load.

This new Hug dirt-moving unit combines proven Hug performance with proven "Caterpillar" Diesel Engine performance. It will move large volumes of dirt and move it fast — operates at 15 miles per hour under full load and 30 miles per hour empty.

NOW — the advantages of low cost operation of the "Caterpillar" Diesel Engine can be realized on the "long-haul" dirt-moving job.

• • •

See the New Hug Tractor Truck on Display at the Road Show, Cleveland, Ohio, January 19 to 24th, 1936.

THE HUG COMPANY

546 Cypress Street
Highland, Ill.

(Top) Model 100 Hug Tractor Truck with 30-yard LeTourneau Cradle-dump Buggy in Dumping Position.

(Center) Model 100 Hug Tractor Truck with 30-yard LeTourneau Cradle-dump Buggy.

(Bottom) The new Hug Model 100 "Caterpillar" Diesel Powered Tractor Truck

BUILT TO MEET A CONDITION

1936 JANUARY 1936

SUN	MON	TUES	WED	THUR	FRI	SAT
Let's go! Everybody off to a flying start on the New Year			1	2		4
5		7	8	OPEN HOUSE AT "AMERICAN HOIST" HEADQUARTERS— AT ROAD SHOW— —SAVE THE DATE		11
12	13		15	16	17	
19	ROAD SHOW STARTS		22	23	ROAD SHOW CLOSES	25
26	27	28	ORDER YOUR NEW "AMERICAN" NOW	31		

THE AMERICAN GOPHER

AMERICAN HOIST & DERRICK COMPANY
SAINT PAUL, MINNESOTA

AMERICAN SINCE 1905 GOPHER SHOVELS

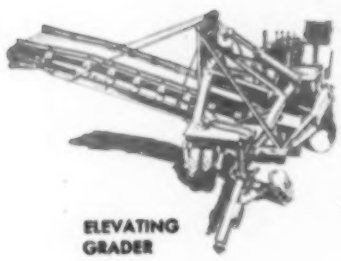
DETROIT PUBLIC LIBRARY

AMERICAN Gopher SHOVELS

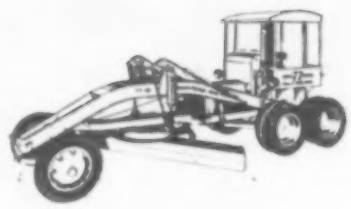
CRANES · DRAGLINES

HYDRAULIC

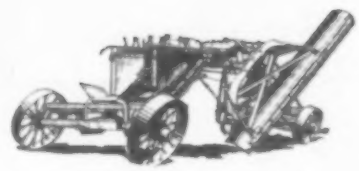
See Our Exhibit at the Cleveland Road Show, January 20-24



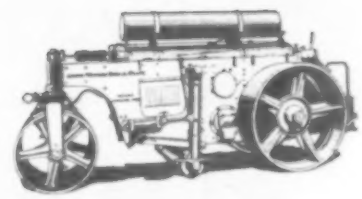
ELEVATING GRADER



MOTOR GRADER



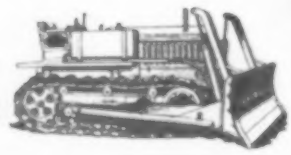
BLADE GRADER



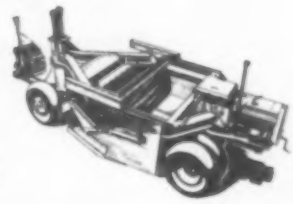
ROLL-A-PLANE

TRAIL CAR

MOTOR SWEEPER



TRAIL BUILDER



12-YARD SCRAPER

SNOW PLOW

Austin-Western

CONTROLS..

An Austin-Western Feature that clinched the title to LEADERSHIP.. in the Road Machinery Industry!

● Four years ago Austin-Western announced its first hydraulically controlled motor grader.

Experience has now proved what tests then indicated, namely: Hydraulic Controls Are the Most Effective Means of Power Control Known to This Industry.

Hydraulic controls are fast. There is not, nor can there be, any lost motion. Control is 100% positive; with the valve closed the ram is locked as in a vise. They have tremendous power to handle any operation easily. They are foolproof. They operate successfully under every condition of weather or temperature. They are cheaper to operate, and cost less for repairs.

Double Supported Ball & Socket Joint
Outlet from Reserve Tank
To other control banks then to reserve tank
'A' Rotary Pump
'B' Valve

Oil travels from rotary pump A to sliding shaft B, set to divert the oil into the right-hand side of the cylinder, above, causing the piston C to move to the left. Movement forces the oil on left of piston to return to valve B. Valve may be shifted to reverse the flow or placed in neutral, locking the oil on either side of the piston at D and E. When flow is stopped at these points a firm wall of oil holds the piston in a vise-like grip, while oil from pump continues to flow freely through the valve.

Austin-Western offers the most complete line of road building and earth moving equipment built by any one manufacturer. Thus the Austin-Western sales staff is free to recommend the machine best suited for the job.

Each piece of equipment has more than fifty years of Austin-Western experience back of it. Today, with hydraulic controls adding a plus value to nearly every machine in the line, this added feature clinches the Austin-Western title to leadership in the roadmachinery industry.

The Austin-Western Road Machinery Co.
Home Office: Aurora, Illinois Cable Address: AWCO, Aurora
Branches in 14 Principal Cities

ROAD ROLLERS · ROAD GRADERS · MOTOR GRADERS · ELEVATING GRADERS · DRAGS
BITUMINOUS DISTRIBUTORS · ROAD-MIX MACHINES · CULVERTS · SCARIFIERS
BULLDOZERS · TRAILERS · SCRAPERS · PLOWS · DUMP CARS
CRUSHING AND WASHING PLANTS · SWEEPERS AND SPRINKLERS
DUMP WAGONS · SHOVELS · CRANES · ETC · SNOW PLOWS

The New INLAND Hi-STEEL...

The Strength and Corrosion Resistance of Inland Hi-Steel Permits Drastic Economies—Greater Efficiency

The New Inland Hi-Steel, the result of two years' research and experimentation, combines superiorities which permit drastic economies in weight, greater efficiency in products and equipment. Any Inland rolled Steel product can be made of Inland Hi-Steel. Truly the Steel of Tomorrow, it offers:

HIGH STRENGTH

About twice as strong as ordinary steel, Inland Hi-Steel will withstand the most severe service. 60,000 lbs. per sq. in. is the minimum yield point in gages lighter than ¼" and 55,000 lbs. in heavier gages.

70,000 lbs. per sq. in. is the minimum tensile strength.

HIGH PAY LOAD

Elimination of useless weight of equipment without decreasing strength or carrying capacity is becoming necessary for all industry. Inland Hi-Steel permits the use of lighter sections and gages, cuts down dead weight and increases pay load.

HIGH CORROSION RESISTANCE

Longer life is also assured by this alloy of balanced elements. Inland Hi-Steel will endure many times longer than ordinary steel under any conditions encountered in manufacturing, mining, construction, and transportation.

HIGH QUALITY

The selection and percentages of the alloying elements determines strength and workability. Inland Hi-Steel can be cut, punched, bent, formed, stamped, seamed and welded with ease and facility.

Inland Steel has long been noted for uniformity. Inland Hi-Steel is remarkably uniform because of the alloying elements used and the method of manufacture.

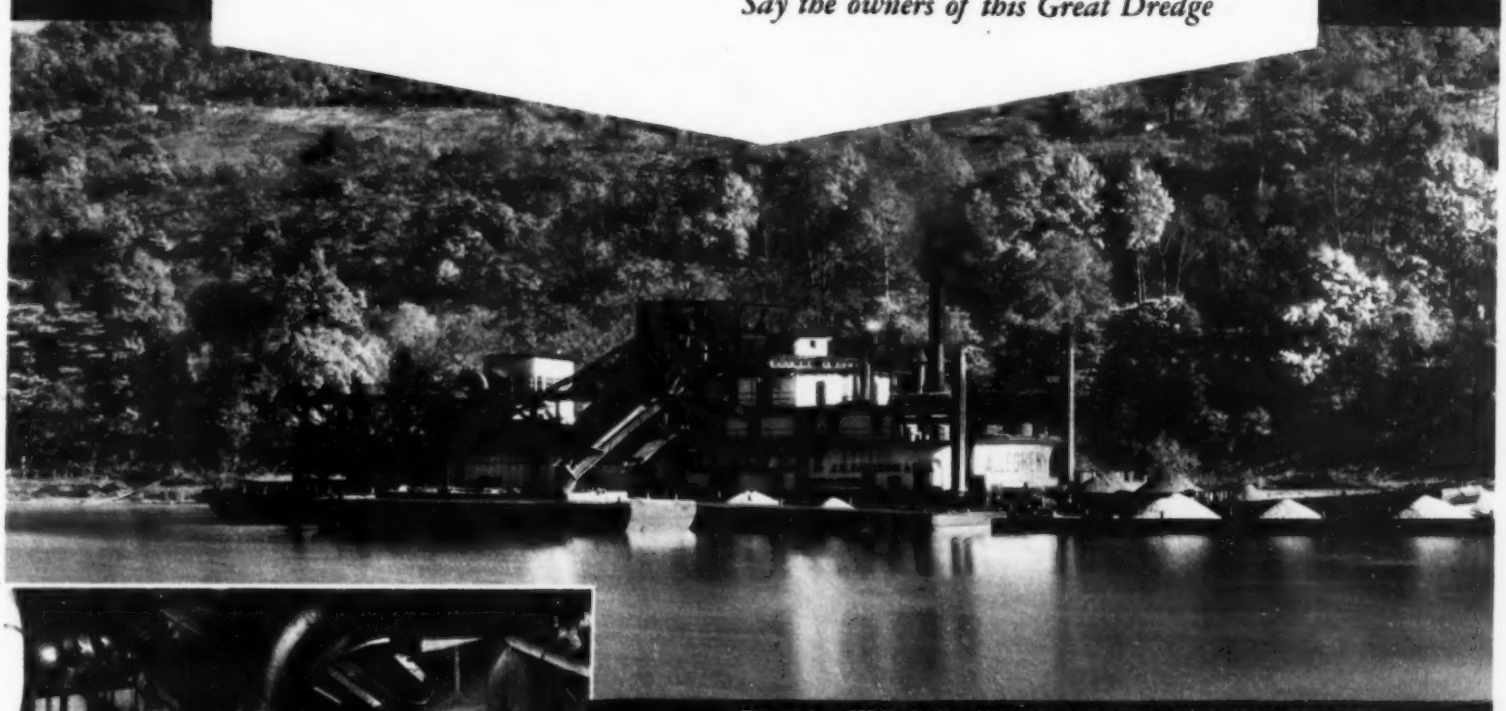
Modernize with Inland Hi-Steel. We will be glad to help you take full advantage of Hi-Steel in the improvement of your products or equipment. INLAND STEEL COMPANY, 38 South Dearborn St., Chicago, Ill.

INLAND STEEL

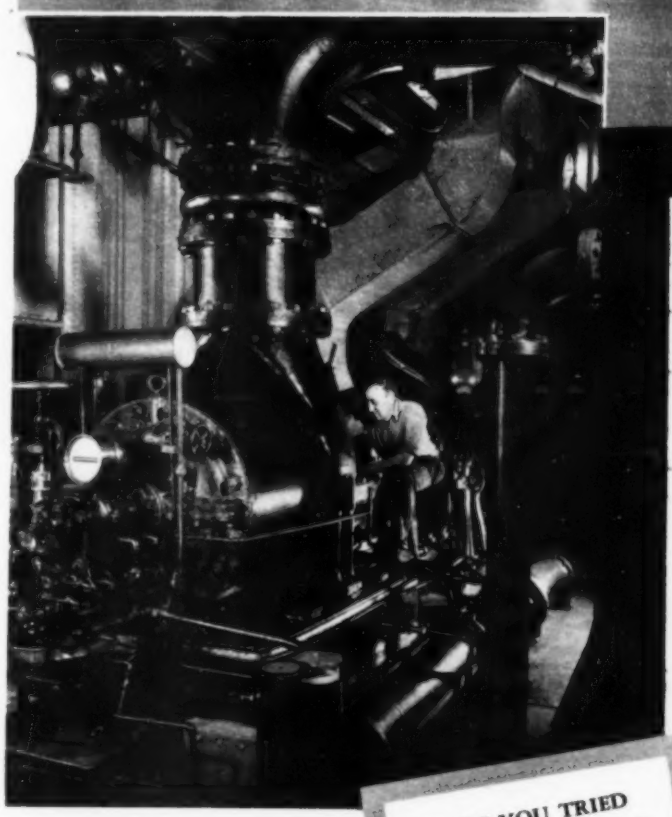
Sheets Strip Tin Plate Plates Structurals Piling Rails Track Accessories Bars Rivets Billets

"We use GULF LUBRICANTS for SAFETY, RELIABILITY and LOW MAINTENANCE COST"

Say the owners of this Great Dredge



The modern 200 ft. dredge, Allegheny, represents a large capital investment. Its owners are protecting all mechanical equipment against wear and repair expense by the use of Gulf quality lubricants and engineering service.



This 500 KW steam turbo-generator supplies power for all the dredge machinery—which is motor driven. With Gulf quality lubricants in use it has given 12 years of continuous service without repairs.

HAVE YOU TRIED THE *New* GULFLUBE MOTOR OIL?

It is the only premium quality motor oil refined by the Multi-Sol process and sold at "regular" price. It is the best motor oil buy a contractor can make.

Gulf Quality Oils and Greases will Improve the Operation of Your Equipment

● "We keep wear and repair expense at a minimum by applying Gulf lubricants to our equipment as the Gulf engineer recommends"—that is the statement of the operator of the great dredge shown above.

All around efficiency of every type of contractors' equipment is improved when lubrication is given careful attention. Savings in repair parts alone will frequently pay the lubricants bill.

Let a Gulf engineer assist you in improving the operation of your equipment. Gulf's broad line of quality oils and greases permits the selection of exactly the right lubricant for each machine you operate. You will be pleased with the economies which accompany the use of Gulf products.

GULF REFINING COMPANY, Pittsburgh, Pa.

BOSTON · NEW YORK · ATLANTA · HOUSTON · LOUISVILLE
PHILADELPHIA · NEW ORLEANS · PITTSBURGH · TOLEDO

GULF INDUSTRIAL LUBRICATION

WATCH a modern Bucyrus-Erie dig . . . notice the sureness with which the dipper holds the grade, the freedom with which it is safely dropped into the pit, the swift thrust through the bank, the invariable heaped load, the quick acceleration of the swing, the sharp stop over the truck and the quick dump. You can't get speed like that without accurate, effortless control . . . and Bucyrus-Eries have it to a superlative degree.

control

BUCYRUS-ERIE

EXCAVATING, DRILLING, AND MATERIAL-HANDLING EQUIPMENT...SOUTH MILWAUKEE, WISCONSIN

YOU CAN GET THE SHOW-DOWN EVERYWHERE

Working day and night, this "Caterpillar" Diesel Tractor cuts the costs and speeds up the work of building a dam near Beach City, Ohio.

Wherever there's dirt to be moved—or any one of a hundred other jobs to be done—there's where you'll learn the "Caterpillar" SHOW-DOWN. You'll see "Caterpillar" Tractors, the 9-to-1 preference on the country's biggest construction jobs. You'll hear talk of the new records for low costs that are being made by "Caterpillar" Diesels. And you'll get the rest of the SHOW-DOWN—the proof of low maintenance costs—from owners who have run their "Caterpillar" Diesels 6000, 8000 hours and more. See your dealer for details of this modern power. Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR

REG. U. S. PAT. OFF.

D I E S E L

Consider
THE WHOLE UNIT

"We ain't hollering about no one gadget or feature." After all, every part that goes into Link-Belt machines must be a champion performer. Link-Belt tolerates nothing but the best throughout the entire structure. When choosing, it's the quality of the entire unit that counts.

STABILITY-POWER-SPEED

From ¾ to 3 yds. capacity, heavy-duty built. Gas engine, Diesel, or electric motor drive. All models can be shipped loaded on a flat car without dismantling.

LINK-BELT

SHOVEL-CRANE-DRAGLINE

LINK-BELT COMPANY, 300 W. PERSHING ROAD, CHICAGO

Offices and Distributors in All Principal Cities

5034-A

Select the Rope that Fits Your Job

Proper selection of Wire Rope is all-important. Every Wire Rope design is planned to resist a given type of destruction. The usual result, however, is loss of resistance to another type of destruction. For instance, few but heavy wires in the strands make a rope that long withstands abrasion but more quickly fails from bending. The rope made of many small wires better resists bending but more quickly falls victim to abrasion. Longest rope service results from the correct compromise of resistance characteristics to meet the destructive forces as they are present in the particular rope use. Let us send you facts to consider when selecting Wire Rope. Write today.

•

WICKWIRE SPENCER STEEL COMPANY, *General Offices:* 41 East 42nd Street, New York. *Sales Offices and Warehouses:* Worcester, New York, Chicago, Buffalo, San Francisco, Los Angeles; *Export Sales Dept.:* New York. WICKWIRE SPENCER SALES CORPORATION, New York, Chattanooga, Tulsa, Portland, Seattle.

WIRE ROPE
by Wickwire Spencer

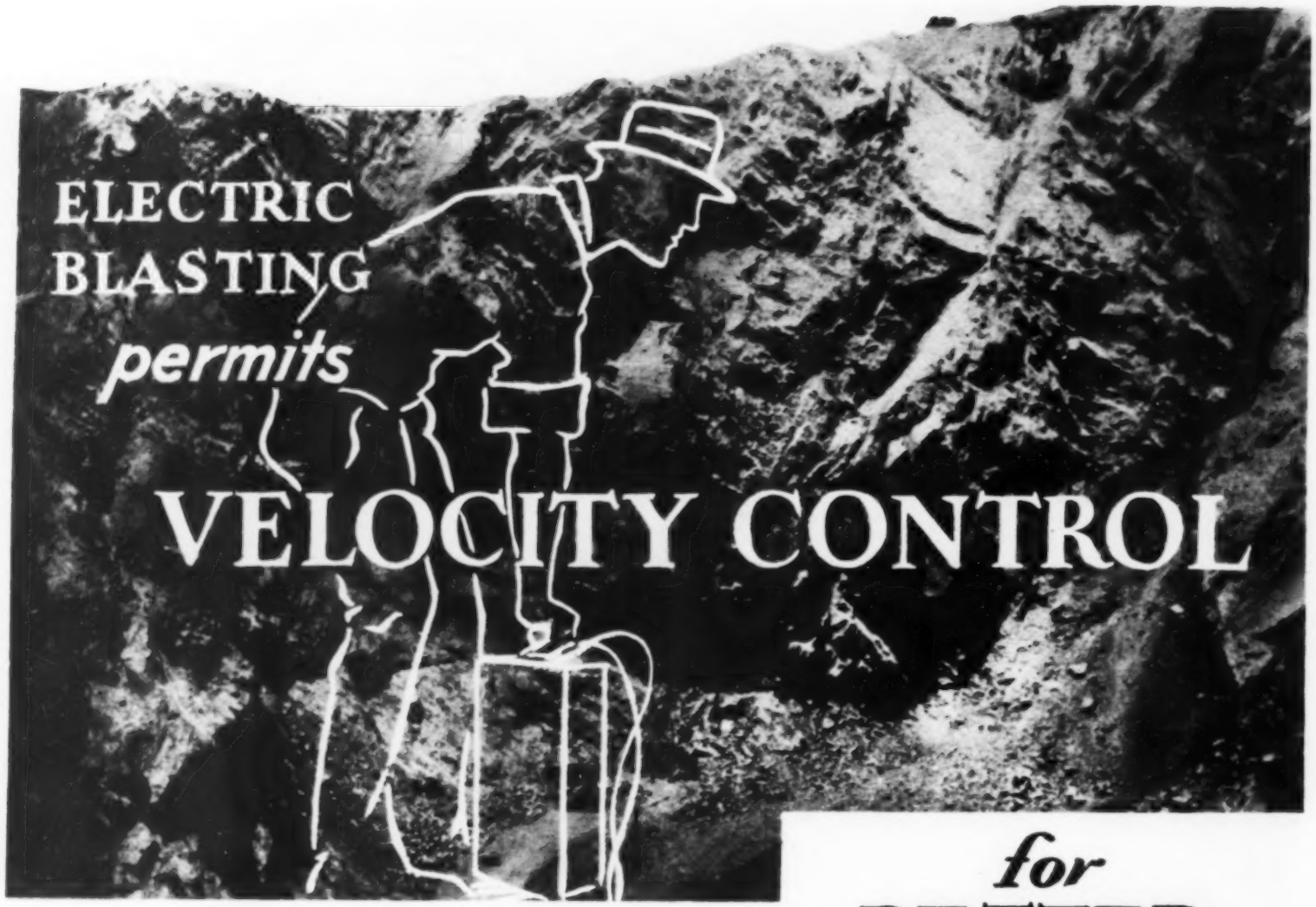
WICKWIRE SPENCER STEEL CO.
41 East 42nd St., New York City
Please send me reprints of previous advertisements which tell "How to make Wire Rope last longer".

Name_____

Firm_____

Address_____

City_____ State_____



for
BETTER BREAKAGE

Electric Blasting makes possible the release of the force of an Explosive at normal velocity. The velocity may be selected which will provide better fragmentation, increased tonnage, and lower blasting costs.

Many kinds of rock formations react favorably to the action of low velocity Explosives. Such Explosives are not increased in velocity by the impulse from an electric detonator.

This thought deserves consideration and study by operators.

Atlas provides Electric Blasting Caps, Explosives and Blasting Machines, and suggests methods of using and selecting Explosives.

Consult the Atlas representative.

ATLAS POWDER COMPANY, WILMINGTON, DEL.

Cable Address—Atpowco

Everything for Blasting

OFFICES

Allentown, Pa.	Joplin, Mo.	New Orleans, La.	Pittsburgh, Pa.	Spokane, Wash.
Boston, Mass.	Kansas City, Mo.	New York, N. Y.	Portland, Oregon	St. Louis, Mo.
Butte, Mont.	Knoxville, Tenn.	Philadelphia, Pa.	Salt Lake City, Utah.	Tamaqua, Pa.
Denver, Colo.	Los Angeles, Calif.	Picher, Okla.	San Francisco, Calif.	Wilkes-Barre, Pa.
Houghton, Mich.	Memphis, Tenn.	Pittsburg, Kansas	Seattle, Wash.	

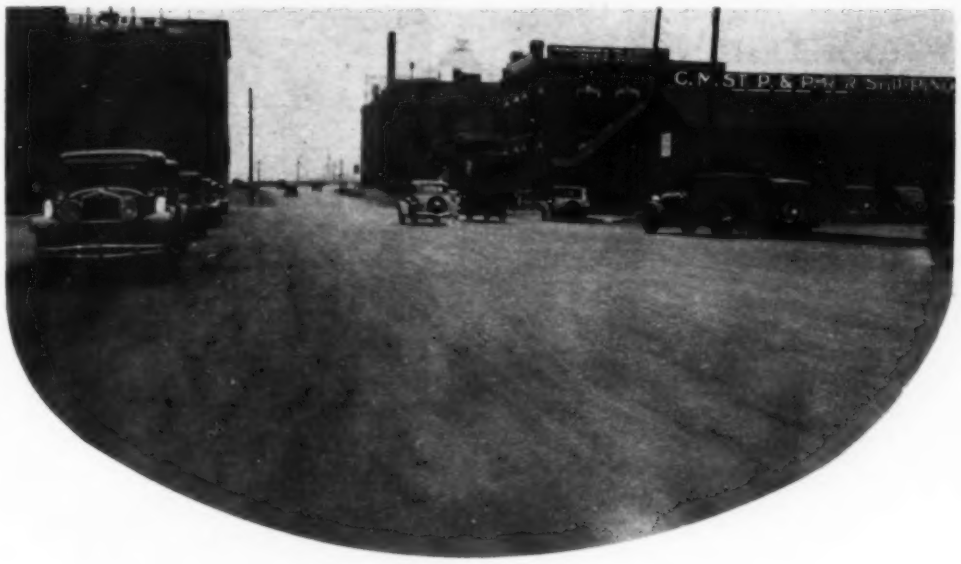
ATLAS
EXPLOSIVES

CHEMICALS ATLAS EXPLOSIVES

19-year-old veteran convinces Minneapolis

(above) TEXACO Sheet Asphalt pavement, after 19 years under heavy traffic of Washington Avenue, North, Minneapolis.

(below) Newly constructed TEXACO Sheet Asphalt on Third Avenue, South, Minneapolis.



Nineteen years ago, the former pavement on Washington Street (North), Minneapolis, had become badly battered by traffic. To save it and provide a new pavement at moderate cost, a new TEXACO Sheet Asphalt surface was laid over the old street.

After 19 years of hard wear, this veteran pavement still is fit for years of added service.

This example of durability was enough for Minneapolis. Last year, when another of its heaviest travelled thoroughfares, 3rd Avenue (South), needed paving, TEXACO Sheet Asphalt again was laid.

Between 1916 and 1935, a considerable portion of this city's system of streets has been TEXACO paved.

TEXACO

Chicago
Cleveland
Kansas City, Mo.
Houston
Dallas

THE TEXAS COMPANY
Asphalt Sales Dept.
135 East 42nd Street, New York City

Buffalo
Philadelphia
Richmond
Boston
Jacksonville

Bid it Right
forget the old stuff!

Half a million yards of concrete for one major bridge job completed last year were mixed in Rex Moto-Mixers—truck and barge mounted.

75,000 yards of this concrete was pumped into the caissons with 4 Rex Pumpcretes.

A record job handled in record time, because the builders saw how smart it was to forget the *old stuff*. Equipment that is already owned, methods of the years before, are often the bottleneck that holds up the job —runs up the cost.

In 1936, before you buy, before you bid, investigate the Up-To-Date Methods of Handling Concrete.

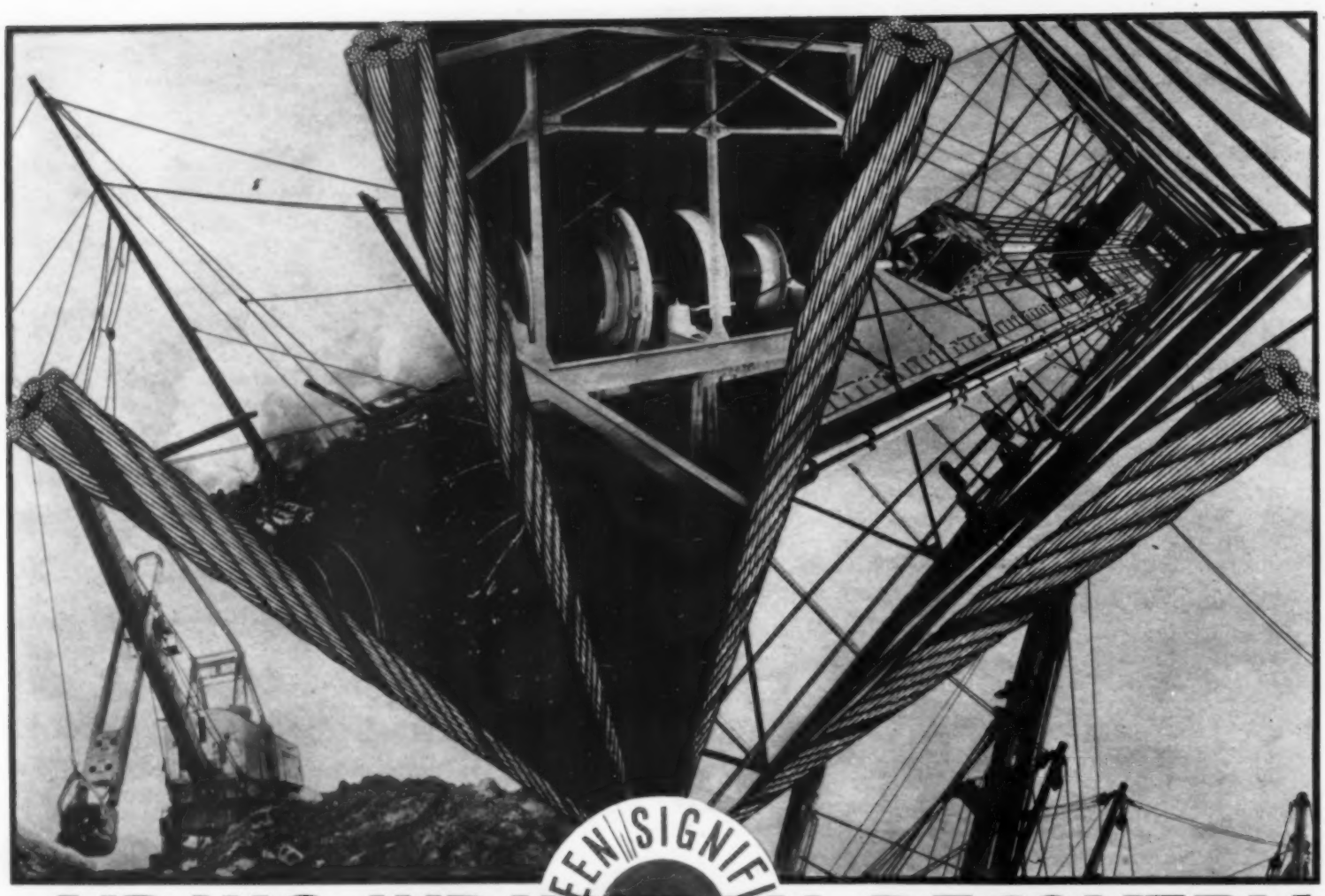
CHAIN BELT COMPANY
1664 West Bruce Street Milwaukee, Wisconsin

The Up to Date Methods of Handling Concrete

REX CHAIN BELT COMPANY

Construction Equipment

IT'S HERE
a new NORTHWEST full-revolving 3/8 Yd. Shovel!
Big Machine Quality at an attractive price
NEVER before a small machine like this!
A small and lighter NORTHWEST of "Sensible Weight" which insures sturdiness, strength and durability — not a "skinned down" weight built purely for price.
SUPER MOBILITY—maneuvers with the ease of a tractor! Steering controlled by the operator with the cab in any position.
FEATHER TOUCH CLUTCH CONTROL retains the feel of the load—fast and smooth operation.
NORTHWEST INDEPENDENT CROWD —utilizes power other shovels waste.
BALL OR ROLLER BEARINGS on all high speed shafts.
FULLY ENCLOSED CAB—Operator protected in all kinds of weather.
LOADS ON A TRUCK OR TRAILER— take it anywhere at motor truck speed.
And there it is! A compact tool for a man sized job! Full-revolving, convertible, mobile and powerful! Be sure to see it before you buy.
NORTHWEST ENGINEERING COMPANY
The world's largest exclusive builders of gasoline, oil, diesel or electric powered shovels, cranes, draglines, pullshovels and skimmers
1730 Steger Bldg. 28 E. Jackson Blvd.
Chicago, Illinois, U. S. A.
SHOVELS, CRANES DRAGLINES PULLSHOVELS SKIMMERS
NORTHWEST
GASOLINE, OIL DIESEL OR ELECTRIC POWERED
BUILT IN A RANGE OF 15 SIZES — 3/8 YD. CAPACITY AND LARGER



AIDING INDUSTRIAL RECOVERY

GREEN SIGNIFIES SAFETY

● In the nation-wide effort for industrial recovery LAY-SET Preformed wire rope is playing an important part. Wherever it is necessary to have economy of operation, increased service from machinery, greater speed of production, or increased safety to workmen—there, LAY-SET is most appreciated. . . . Back in 1928 hundreds of operators found that LAY-SET Preformed handles easier, works better, lasts longer, gives greater dollar value. Since then literally thousands of operators, in every field, have learned the same thing. . . . It will pay you to investigate LAY-SET Preformed.

HAZARD WIRE ROPE COMPANY, Inc.
Wilkes-Barre, Pennsylvania
An Associate Company of the American Chain Company, Inc.

In Business for Your Safety

District Offices: New York, Chicago, Philadelphia, Pittsburgh, Ft. Worth, San Francisco, Denver, Los Angeles, Birmingham, Tacoma

GREEN SIGNIFIES SAFETY

LAY-SET *Preformed* Wire Rope

★ ALL HAZARD WIRE ROPES MADE OF IMPROVED PLOW STEEL ARE IDENTIFIED BY THE GREEN STRAND

Before completing your 1936 road plans, talk them over with the Tarvia field man. He has at his disposal all The Barrett Company's 32 years of successful experience in low-cost road construction and maintenance, and offers you practical, unobtrusive, money-saving cooperation. He can show you how to meet immediate and future needs with easy-to-build Tarvia roads—roads that require only the most inexpensive maintenance to keep them smooth, easy-riding and skid-safe for many years. Phone, wire or write our nearest office.

Meet us at Booth F-8 at the Road Show, Cleveland, week of January 20.

THE TECHNICAL SERVICE BUREAU of The Barrett Company invites your consultation with its technically trained staff, without cost or obligation. Address The Technical Service Bureau, The Barrett Company, 40 Rector Street, New York.

Spruce Street, Sault Ste. Marie, Mich. Tarvia-built in 1919. Top photo shows Spruce Street as it looked the year it was built. Lower photo shows the condition of the road last summer—how it will look in 1936.

THE BARRETT COMPANY New York Chicago Philadelphia Birmingham Boston St. Louis Cleveland Minneapolis Lebanon Milwaukee Detroit Baltimore Columbus Youngstown Toledo Buffalo Providence Syracuse Hartford Cincinnati Bethlehem Rochester Portland, Me. In Canada: THE BARRETT COMPANY, LTD. Montreal Toronto Winnipeg Vancouver

Cities Organize in Safety Drive
COUNTRY ALARMED OVER MOUNTING AUTO DEATHS
Civic Leaders Aroused
Two Drivers Get Stiff Fine; Jailed
Legislature To Pass New Driving Law

NATION DECLARES WAR ON ACCIDENT TOLL

White Concrete Markers HAILED AS AID IN SAFETY DRIVE

"Keep in your lane!" say these Atlas White Concrete Traffic Markers on the Saugus River (Point of Pines) Bridge in Massachusetts. Center markers 8-inch wide. Broken markers 6-inch wide. Markers built on concrete base as curbing with asphalt top applied later. Installed for Massachusetts State Highway Dept. by C. J. Maney Construction Co., Boston.

● Here's a statement that's hard to believe:—In the last fifteen years 144,579 *more* Americans have been killed in automobile accidents than were killed in all the wars of our history!

Most of the fault must of course be laid smack in the laps of reckless drivers. But, despite earnest efforts to curb reckless driving, highway and traffic officials realize that what solution there is to the problem lies in making streets and highways as fool-driver proof as possible.

Permanent white concrete traffic markers are one thing officials have found helpful. These white concrete markers, made with *white* portland cement, combine constant visibility with economy. They are not merely surface markers—they are built right into the pavement—asphalt, brick or concrete. They can't be worn away. They never fade out. They are always white—always easy to see. Once in, they're in for good. We'll be glad to send you complete information. Address Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), 208 South La Salle Street, Chicago.

Help Build Safety into Streets and Highways with

ATLAS WHITE TRAFFIC MARKERS

Made with Atlas White Portland Cement—Plain and Waterproofed

Construction Methods

ROBERT K. TOMLIN, Editor

Established 1919—McGraw-Hill Publishing Company, Inc.

Volume 18—Number 1—New York, January, 1936

WING ATTACHMENTS on blade of standard grader shape oiled rock spread for 3-ft. border.

SPECIAL ATTACHMENTS AID *Standard Equipment on* OIL ROCK STRIP

SPECIAL ATTACHMENTS on a standard box spreader and on a blade grader have proved effective, the California Division of Highways has found, in placing material for a 3-ft. wide oiled-rock border along a mile of 20-ft. wide asphaltic concrete pavement in Fresno County. Both devices, employed on a contract on state route No. 4, are described in a report by R. S. Bader, district engineer, to C. S. Pope, construction engineer, the source of the following notes:

To the bottom of an 8-ft. box spreader were bolted two steel shoes with upturned front ends, one riding on the pavement and the other on the earth shoulder of the road. Flanges on the shoes guided the spreader box along the pavement edge and retained the oiled stone within the required 3-ft. width of border. The outer shoe, in two parts, and the flanges were adjustable to permit placing the 6-in. depth of stone in two courses.

Material was spread by a 2½-ft. blade attached to the regular adjustable blade of the spreader box. The chains of the spreader box were fastened high on the trucks to raise the front ends of the shoes 1½ in., thus causing the weight of the box to be partially carried by the truck to prevent gouging of the earth shoulders. Inside the box, on each end, ¼-in. steel plates formed two false bottoms sloping toward a 2½-ft. opening in the middle through which the oiled rock was spread. After placement, the material in the borders was compacted by rolling with the tires of a loaded dump-truck.

SPREADER BOX is equipped with steel shoes and false-bottom plates sloping toward 2½-ft. discharge opening.

The attachment applied to the road grader, used to shape the material deposited by the spreader box, consisted of two winged flanges, one at the end of the blade and the other 3 ft. from it, as illustrated. The action of the blade and wings was similar to that produced by the screed of a mechanical finisher, as the compartment formed by the grader blade and wings was kept full of material and fed or cut as the surface required. Behind the blade was attached a small wood drag to push back on to the 3-ft. border width material that was spilled out by the grader blade.

After the material was allowed to cool and set for some time it was given a final rolling. In charge of this contract for the California Division of Highways was F. W. Howard, resident engineer.

This Month's "NEWS REEL"

DIFFICULT HIGHWAY LOCATION is presented by new route along precipitous face of Grizzly Dome in Feather River Canyon, California. Supported by ropes, members of drilling and blasting crew attack east portal of tunnel through which highway will pass to provide mountain gorge route for California Division of Highways.

7,500 CU. YD. PER DAY in three 7-hr. shifts is quantity of earth loaded by power-driven Adams elevating grader on Loup River Public Power District project, Columbus, Neb., for George W. Condon, Omaha contractor. Earth is hauled in 8-yd. Euclid truck trailers to build 45-ft. embankment around Lake Babcock reservoir.

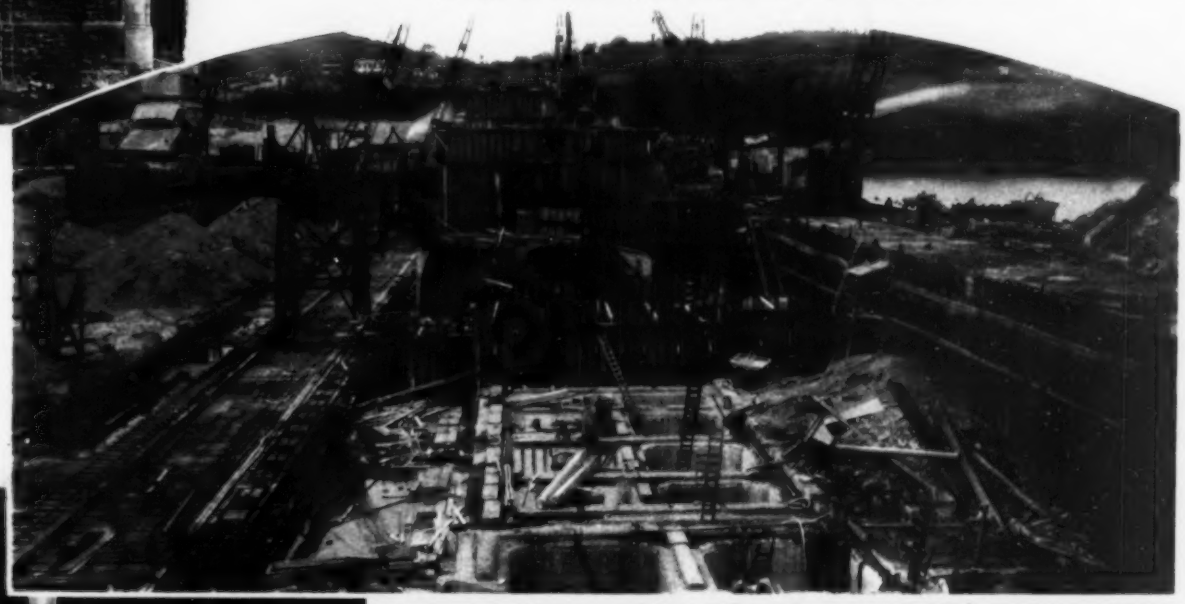
FIRST POUR OF CONCRETE *(right)* enters forms at Grand Coulee dam on Columbia River Dec. 6. Governor Clarence D. Martin of Washington unlatches bottom-dump bucket on $63,000,000 power and irrigation project on which first contract for $29,339,301 is being executed by Mason-Walsh-Atkinson-Kier Co., under direction of F. A. Banks, construction engineer for U. S. Bureau of Reclamation.

SAFETY LIGHTING SYSTEM, producing high visibility without glare for night driving, is installed on 10 mi. length of concrete highway at Chagrin Falls, Ohio, 15 mi. southeast of Cleveland. Spaced 125 ft. apart and mounted 5 ft. in from pavement edge at height of 25 ft., forty 4,000-lumen General Electric incandescent lamps are equipped with aluminum reflectors of new "terraced" design.

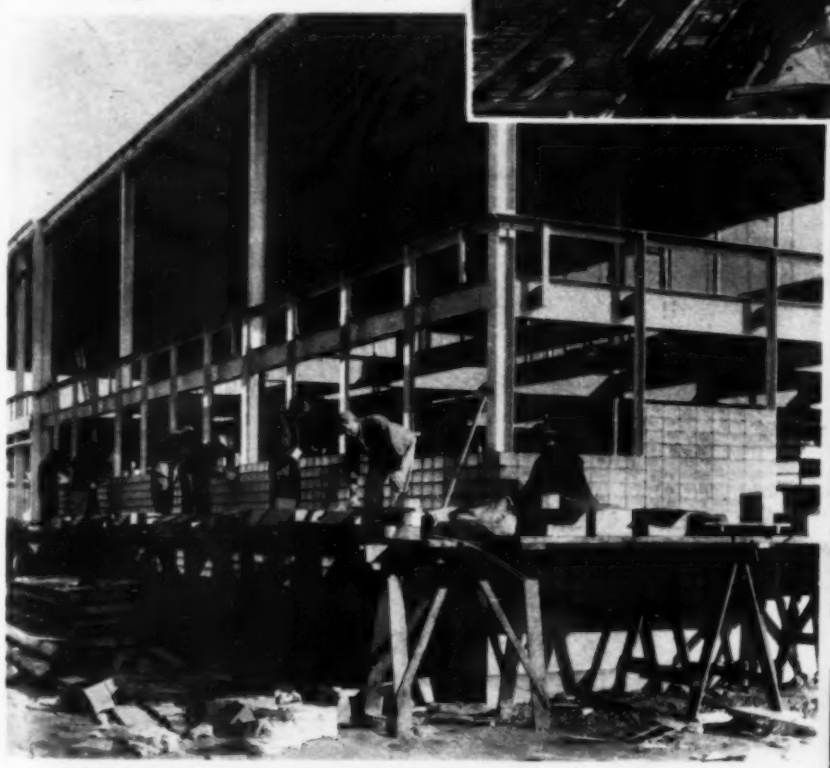
F. A. BANKS, (right) construction engineer, U. S. Bureau of Reclamation, is congratulated by Gov. Clarence D. Martin, of Washington, on placing of first bucketful of concrete in Grand Coulee dam Dec. 9, as illustrated in upper photo

GRAY TOWER OF BLACKSBURG. New administration building for Virginia Polytechnic Institute is completed on school's campus at Blacksburg, Va. as part of construction program financed with $1,066,000 PWA allotment.

REDWOOD HIGHWAY DEDICATION in California, completed last summer, is occasion of picturesque ceremony featuring Indian characters in native costume. Governor Merriam cuts ribbon opening 7-mi. length of Benbow-Garberville route as Earl Lee Kelly, Director of Public Works, (to right of Governor) and other state officials look on.



OPEN CAISSON FOUNDATIONS sunk through sand and gravel to bedrock 42½ ft. below normal pool level feature construction of Montgomery Island lift-gate dam 1,379 ft. long in Ohio River 4 mi. below Beaver, Pa., by Booth & Flinn Co., Inc., of Pittsburgh, for Corps of Engineers, U. S. Army.



TRANSLUCENT GLASS BLOCK are being used to form the exterior walls and inside partitions of a new windowless two-story, 140x100-ft. laboratory building being constructed by the Owens-Illinois Glass Co. at Toledo, Ohio. Tests at Purdue University have indicated superior insulating properties for glass blocks and crushing strength of 2,000 lb. per square inch. Variations of light transmission and prevention of glare are obtained through a variety of face cuttings on block. Glass blocks are laid up in walls with mortar like building brick.

FOUNDATIONS FOR BONNEVILLE SPILLWAY DAM, 1,250 ft. long and 170 ft. high, across main channel of Columbia River are poured at night within cofferdam area with aid of floodlights. View shows south half of structure on Oregon side. At top of picture, on Washington shore, are aggregate and concrete mixing plants of Columbia Construction Co., which is pouring concrete at rate of 2,000 cu.yd. per 24 hr. under direction of Corps of Engineers, U. S. Army.

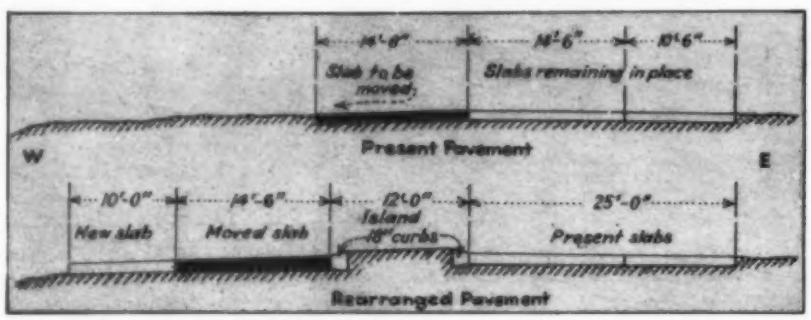
PNEUMATIC JACKING

With Inflated Hose Separates Pavement Slabs to Form Traffic Safety Island

PNEUMATIC JACKING with the aid of long lines of hose, alternately inflated with compressed air and deflated to produce successive lateral "shoves," is the method developed and used for the first time by the New Jersey Highway Department to build safety into one of its main trunk routes by moving apart the slabs of an existing four-lane concrete pavement to provide space for a continuous "safety island" extending along the center of the widened highway. The improvement will convert the existing 39½-ft. width of pavement into two 25-ft. roadways, separated by a 12-ft. grass-covered strip to prevent collisions between northbound and southbound traffic which had been occurring on this thoroughfare with alarming frequency.

The unique operation, applied to a 7-mi. length of the Brunswick Turnpike a few miles south of New Brunswick, N. J., on U. S. Highway No. 1 (N. J. State Route No. 26), main route between New York, Trenton and Philadelphia, involves an ingenious application of air pressure to move sideways a total distance of 12 ft. slabs of concrete pavement 14½ ft. wide in sections 500 ft. long weighing 400 tons. Along the outer edge of the relocated line of slabs a new 10-ft. traffic lane is built to widen the route and the final stage of the improvement consists in building curbs along the outer edges of the central safety island and seeding the area between them to create a grass-covered traffic separation strip. The general scheme of slab movement by pneumatic jacking and the details of method and equipment for its operation were developed by Sigvald Johannesson, engineer of design, of the New Jersey Highway Department.

LATERAL MOVEMENT of 14½-ft. wide concrete slab, in sections 500 ft. long, is accomplished by inflating hose between pavement edge and wood headers backed by follower blocks between transverse struts.



BEFORE AND AFTER slab is shoved sideways 12 ft. Note central safety island and new 10-ft. widening strip on west side of improved highway on New York-Philadelphia route.

At the point where this project of trunk-line highway improvement was undertaken State Route No. 26, extending in a southwesterly direction from New Brunswick to Trenton, is 39 ft. 6 in. wide and consists of three 9-in. thick flat concrete slabs, of which the one on the easterly side is 10½ ft. wide and the other two are each 14½ ft. wide. Between pairs of transverse joints the slabs are 34 ft. 4 in. long. Although the paved width of the roadway is marked off by painted lines into four traffic lanes, each about 10 ft. wide, numerous accidents to fast moving vehicles on this New York-Philadelphia route led to the decision not only to widen the roadway but also to separate northbound and southbound traffic by a central safety island. This was accomplished by allowing the two easterly slabs of the pavement (aggregating 25 ft. in width) to remain in place and moving the westerly slab (14½ ft. wide) sideways a distance of 12 ft. and adding a new 10-ft. concrete slab by methods and equipment described in the following notes:

Preliminary Operations—It was necessary, first, to grade a width of 22 ft. beyond the westerly edge of the original pavement to form a bed for the 14½-ft. slab as it was shoved 12 ft. sideways and also provide additional subgrade for the new 10-ft. lane of concrete laid along its outer edge to widen this half of the divided pavement. The grading work was done by hand labor methods to give employment to a large number of men on local relief rolls. The subgrade material consists of a mixture of loam, sand and gravel. No grading was done along the east edge of the

SUBGRADE has been prepared to receive 500-ft. section of slab to be moved 12 ft. laterally. Movement of slab in foreground completed.

GAP 12 FT. WIDE has been opened up by moving slab to provide space for traffic-separating safety island.

SPECIAL PLOW with removable cutting blade is designed to gouge premoulded bituminous filler from longitudinal joint.

HAND LABOR is used in preparing new subgrade at side of present pavement to give employment to men on relief rolls

SIGVALD JOHANNESSON, engineer of design, New Jersey Highway Department, who devised slab-jacking methods and equipment.

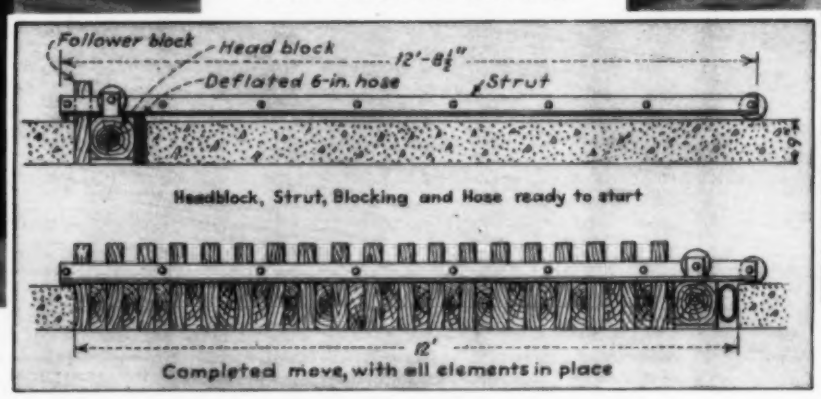
pavement as the existing earth shoulder on this side, supplemented by the weight of the 25-ft. width of 9-in. pavement left in its original position, served as an abutment for receiving the reaction of the pneumatic jacking operations on the west slab.

Preparatory to actual jacking two operations were performed: The first consisted of cutting the 14½-ft. pavement slab (9 in. thick) transversely at the ends of the 500-ft. sections to be moved. These cuts, about 3 in. wide, were made with pneumatic drills at transverse joints containing steel dowel bars that had to be severed. The second operation involved the removal of the premolded bituminous filler from the ½-¾-in. longitudinal joint along the inner edge of the slab to be moved in order to provide space for the insertion of flat "ribbons" of deflated 3-in. hose later expanded with compressed air for the first lateral shove.

Removal of Joint Filler—For the removal of this joint filler a special steel "plow" was designed. As illustrated, it consists of a pair of angle-iron runners between which is bolted a removable steel cutting blade ⅜ in. wide. The device, with cutting blade inserted in the joint opening, is hauled by a 10-ton roller at speeds of 3 to 4 mi. an hour and gouges the filler material out of the joint in strips. There are no transverse steel dowel bars between slabs to interrupt the passage of the plow. The operation requires two passes of the plow, the first with the cutting blade set to remove filler to a depth of 4 in. and the second to remove filler to a depth of 7 in. While the thickness of the pavement and of the joint material is 9 in., a joint opening 7 in. in vertical depth is sufficient to receive the first lengths of flattened, deflated 3-in. jacking hose. After the second passage of the plow the joint is given a final clearing out with hand picks having shanks flattened to ⅜ in., thus leaving a joint opening ½ to ¾ in. wide and 7 in. deep to receive the first lengths of deflated hose for the pneumatic jacking operation.

Jacking with Hose—Into the longitudinal joint thus opened up for the entire 500-ft. length of the slab section to be moved as a unit is inserted interconnected 100-ft. lengths of 3-in. U.S. linen fire-hose flattened out to a ribbon

JACKING EQUIPMENT (*below*) in place at beginning and end of 12-ft. lateral movement of slab, showing relation of 6-in. hose, head timbers, follower blocks and transverse struts.



STRIPS OF JOINT FILLER are removed by two passes of plow, cutting to depths of 4 and 7 in., respectively.

TRANSVERSE CUTS are made by drills at ends of 500-ft. section of slab to be moved sideways by process of pneumatic jacking.

RUBBER HOSE, 3 in. in diameter, flattened to thin "ribbon", is inserted in joint opening for inflation to cause initial shove.

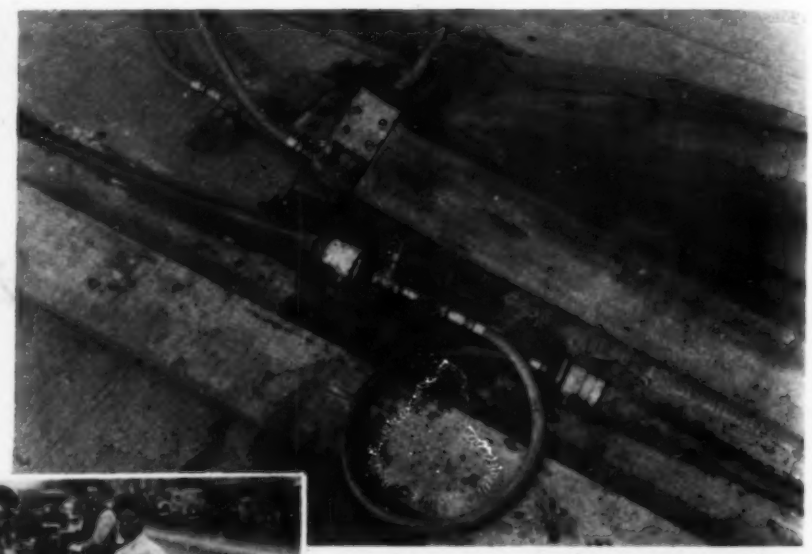
only ¼ in. thick to fit into the ½-¾-in. joint slot. This flattening is done by wetting the hose, applying graphite to its exterior, and ironing it out on a level surface with a hand roller, as illustrated Ordinary brass couplings between 100-ft. lengths of the 3-in. hose are allowed to extend above the joint opening at each connection.

With the flattened 3-in. hose in place in the longitudinal joint for the entire 500-ft. length of concrete slab to be moved, air from a compressor plant comprising two Ingersoll-Rand portable gasoline-driven units, each with capacities of 210 cu.ft. per minute at 110 lb. per square inch, and with separate 144-cu.ft. tank receivers, is admitted to the hose line. Air pressure at the receivers is about 100 lb. per square inch and in

FLATTENING of 3-in. hose for insertion into longitudinal joint is done by "ironing out" on smooth surface with roller.

the outlet valves between the interconnected 31½-ft. hose lengths and 3-in. planks are inserted behind the hose, which is again inflated to produce a shove of about 3 in. and widen the joint opening to 8 in. After again deflating the hose, 3½-in. wood blocking is placed behind the 3-in. planks, a new shove is made and the operation repeated with additional 3½-in. blocking until the joint has been opened to a total width of about 15 in. At this stage the planks and blocking are removed and header blocks in the form of 9⅝x9⅝-in. yellow pine timbers, each 15 ft. 2 in. long, are laid behind the line of hose along the edge of the pavement throughout the 500-ft. section being moved. The pneumatic jacking is then resumed in successive shoves of 3½ in.

FLAT COUPLING for 6-in. jacking hose is designed to fit into opened longitudinal joint.

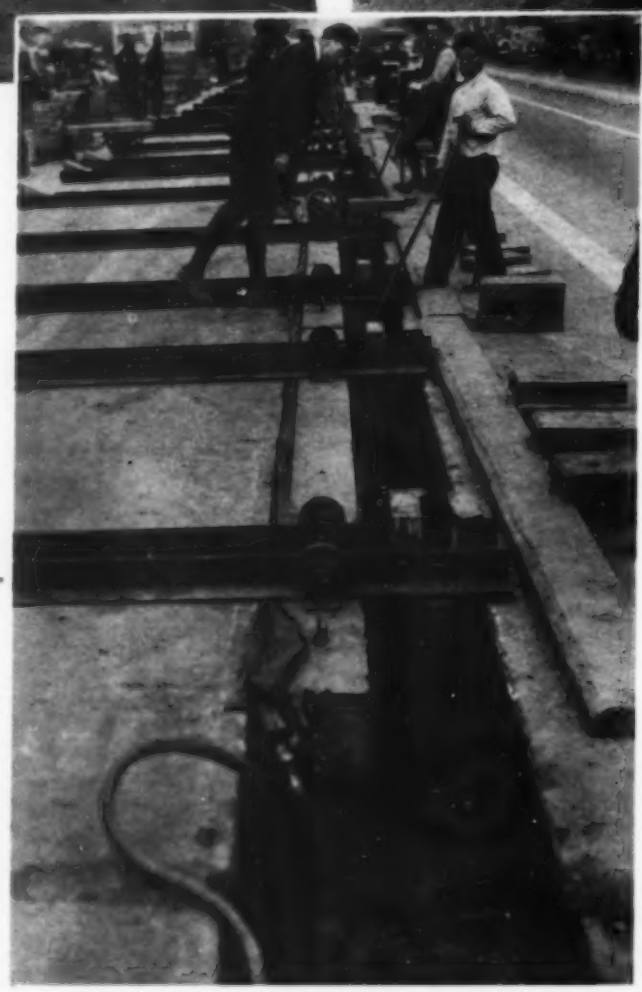


CIRCULAR COUPLINGS for 3-in. hose, used only for first shove, protrude from joint.

the hose line which does the jacking, about 80 lb. per square inch. The air receivers feed the jacking hose through lines of 1-in. rubber hose aggregating 1,400 ft. in length. Admission of air is regulated from a control table with a single valve. As the compressed air dilates the hose in the longitudinal joint of the pavement the westerly line of 14½-ft. concrete slabs is shoved sideways until the joint opening is increased to about 1¾ in. The remaining 2-in. of premolded joint filler not previously plowed out is then removed.

After the first shove the 3-in. hose is removed and replaced with larger U. S. Rubber Co. cotton-jacketed, rubber-lined 6-in. hose, interconnected in 31½-ft. lengths (one length for each 34 ft. 4-in. slab unit between transverse joints) by special flat couplings narrow enough, as shown in one of the photographs, to fit into the joint opening as enlarged by the first shove with the 3-in. hose. An air relief valve is installed at each connection of hose lengths. With the 500 ft. of joint opening filled by a line of deflated 6-in. hose (wrapped in a protective sheet of canvas duck) air is again applied to move the slabs and increase the width of the joint opening to about 5 in.

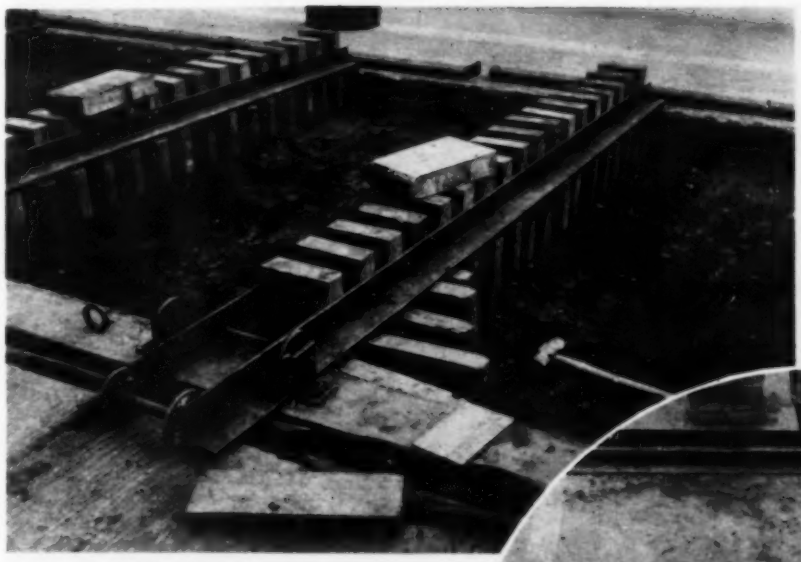
The hose is then deflated by opening



READY FOR A SHOVE. Deflated 6-in. hose, ready to receive compressed air, is held against side of 500-ft. section slab to be moved by timber headers, backed up with 3½-in. wide follower blocks set between transverse angle-iron struts.

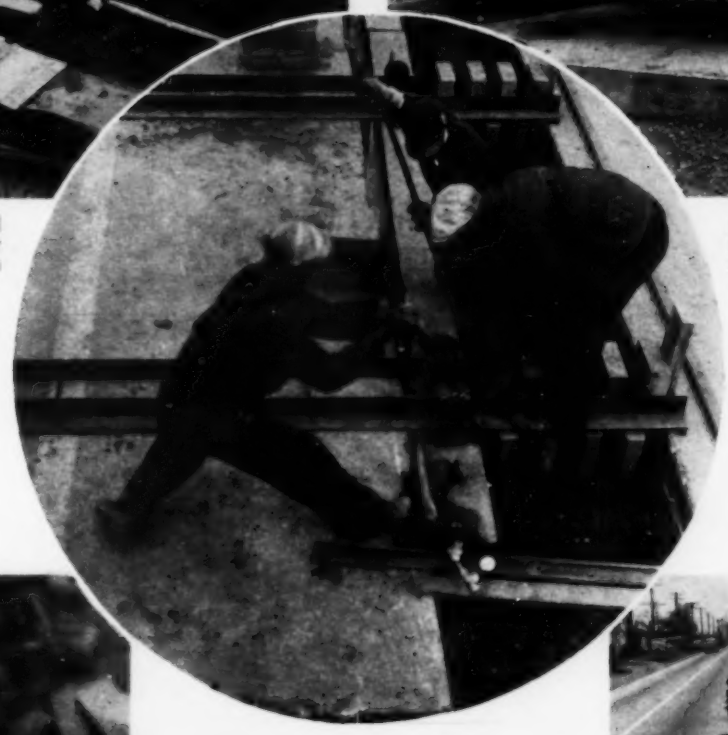
each and after each shove wood follower blocks measuring 3½x9⅝x18 in., tapered ¼ in. on each long side, are inserted behind the header timbers to take up the "slack" created by the lateral movement of the line of slabs. Four sets of blocking and two header timbers are set for each length of 34 ft. 4 in., the distance between transverse joints in the slabs.

To hold each set of blocking in place there is used a strut, or frame, consisting of a pair of 4x4x⅜-in. angle irons, 12 ft. 8½ in. long, spaced 18 in. back to back and held together by ¾-in. transverse bolts. The edges of the angle irons pass under a pair of roller guides on the header blocks, as illustrated, and are carried at their far ends by wheels which allow the slab to move under them during jacking. For each slab length of 34 ft. 4 in. three men place the blocking, manipulate the air inlet and discharge valves and, after a shove is completed and the 6-in. hose deflated, pry the header blocks forward with steel crowbars to make space for the insertion of new 3½-in. wide follower blocks. The cycle of operations described—inflation of hose, 3½-in. shove of slab by pneumatic pressure, deflation of hose and insertion of new follower



SHOVE COMPLETED. Slab in foreground has been moved sideways 12 ft. and follower blocks between struts are being knocked down for transfer to new setup.

READY FOR TRANSFER to new setup. Blocking and struts from completed jacking operation are loaded upon four-wheel trucks and moved ahead.



PREPARING FOR NEW SHOVE *(above)*. Against deflated 6-in. hose the head block is pried over by crowbars and new 3½-in. follower block is dropped into place between transverse angle-iron struts.

MUD JACK *(below)* pumps fluid mixture of top soil and cement through drilled holes to insure proper bedding of moved slabs.

CONTROL VALVE admits compressed air to 1-in. hose lines feeding 6-in. jacking hose.

BLOCKING IS DISMANTLED after completion of 12-ft. shove to form longitudinal safety island.

blocks—is repeated until the 500-ft. line of slabs has been moved laterally the required distance of 12 ft. into its new position. The equipment is then moved ahead and operations repeated on the next 500-ft. length of slab.

Each shove of 3½ in. requires about 500 cu.ft. of compressed air. Progress averages about 600 lin.ft. of slab moved laterally 12 ft. in an 8-hr. day. Each shoving cycle with the 6-in. hose consumes about 5 min.

In actual practice this method of slab movement has been highly successful. The novel use of air to inflate a long line of hose along the vertical faces of the 9-in. thick slabs assures a uniform pressure throughout the entire length of the 500-ft. section of pavement and the alignment, as shoving proceeds, is no less perfect than that of a company of West Point cadets marching on parade. The use of hydraulic jacks was considered in planning the operation but they would have required cutting recesses in the slabs to provide space for setting the jacks and would have presented problems of equalizing the pressure along the sides of the slabs.

Mud Jack—After the line of slabs has been moved over to its new position a mud jack, pumping a mixture of 6 parts of top soil to 1 part of cement through holes drilled in the concrete, brings the slabs to proper grade and provides for them a stable and uniform bedding surface underneath the concrete. The new 10-ft. concrete traffic lane along the westerly edge of the relocated slabs is then poured and finished by standard paving methods and equipment.

The final operation consists in building 18-in. concrete curbs, using white cement for extra visibility, along the outer edges of the central safety island strip, bringing the earth surface between them to proper grade and sowing seed to produce a grass-surfaced traffic-separation strip.

Personnel — The present operation, being performed by force account with relief labor resulting in the employment of about 300 men, is confined to 7 mi. of the Brunswick Turnpike, but will probably be extended, under contract, to cover an additional 33 mi. of the same route. Under the general direction of Major W. G. Sloan, state highway engineer, and following the general plan and procedure devised by Sigvald Johannesson, engineer of design, the project is handled by the Maintenance Division of the New Jersey Highway Department, of which A. W. Muir is superintendent.

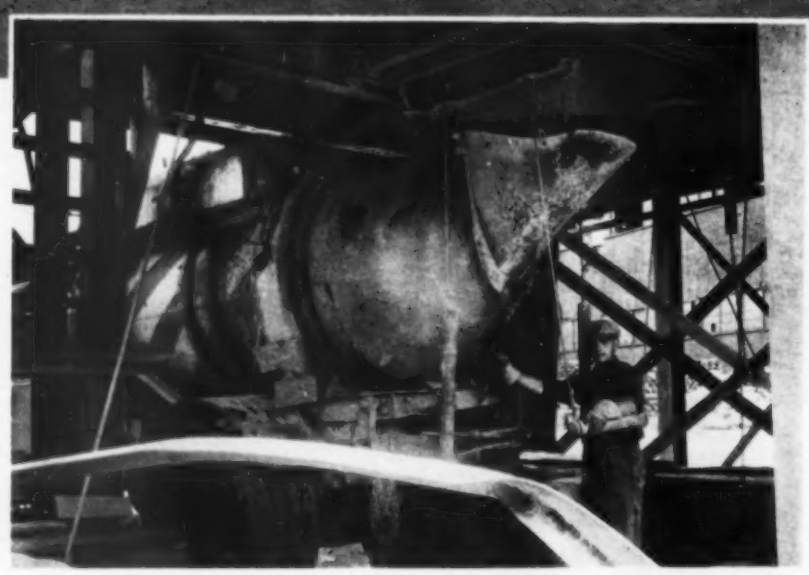
TRANSIT-MIXED TAR-MASTIC

Forms Cushion for Brick Pavement

TRANSIT-MIXERS, instead of the usual stationary batch equipment at the site, were employed effectively to produce the tar-sand mastic cushion spread on a concrete base to support nearly a mile of brick pavement built last summer to improve Penn Ave., forming a portion of U. S. Route 22 and 30 in the Borough of Wilkinsburg, Pa., adjoining the city of Pittsburgh. At the material yard of the contractor, the McCrady-Rodgers Co., in Braddock, Pa., a transit mixer was charged, by gravity, with 4 tons of river sand and then proceeded to the local plant of the Koppers Products Co. where hot Tarmac was introduced into the revolving drum containing the sand. The proportions of the mix, by weight, were 95 per cent of sand and 5 per cent of tar. Thus charged, and with its drum revolving, the transit-mixer traveled a distance of 3.7 mi. to the job where the batch of tar-sand mastic material, thoroughly mixed, was deposited in piles for spreading in advance of the brick paving operations.

TRANSIT MIXER *(right)*, **charged with 4 tons of sand, deposits tar-mastic cushion material in piles for spreading to ¾-in. depth on base.**

TAR-MASTIC CUSHION, *(below)* **supports paved brick surface. Brick in foreground ready for application of hot asphalt joint filler.**



LOADING of transit mixer with sand for cushion course is done by gravity from overhead bins at contractor's yard. Tar is added later.

The total length of the project, constructed under the direction of the Pennsylvania Highway Department, was 5,134 ft., with a paved width of 36 ft. The first section, 600 ft. long, with a double-track street car line, started at the line between the City of Pittsburgh and the Borough of Wilkinsburg on Penn Ave. A second section, 830 ft. long, with no street car tracks, joined the 600-ft. section. The third section, separated from the other two and having a single-track street car line in the center of the street, was 1,191 ft. long. The existing pavement between the tracks of this car line was stone blocks, which were not replaced by new pavement. The street car tracks on the 600-ft. section were paved with brick. A fourth section, 2,513 ft. long, was located on Route 22 just beyond the junction between that route and Route 30.

To support the new brick pavement on its tar-mastic cushion the contractor first poured a concrete base, 8 in. thick, using transit mixers for the delivery of the batches. The mix was 1:2:4, by

TAR*(above)* **from tank car is transferred to drum of transit mixer by pumping weighed batches.**

WEIGHING *(left)* **of batch of tar is done by scales carrying drum fitted with steam coil. Pump delivers weighed batch to mixer drum.**

volume, using crushed gravel as the coarse aggregate. In its 36 ft. of width the concrete base was given a crown of 4½ in. and was screeded to produce an accurate surface profile on which to cushion the brick.

To a uniform depth of ¾ in. upon the finished concrete base was spread, by hand, the piles of tar-sand mastic delivered by transit mixer. Tar for the cushion course met the Pennsylvania Highway Department's DH-2 specification, having a specific viscosity, Engler, of 14 to 22 at 50 deg.C. In preparing the mix tar was discharged by gravity from a tank car into a steel drum, mounted on scales and equipped with a heating coil, from which it was pumped into the transit mixer through the spray bar ordinarily used for the introduction of water into concrete mixes. The mixer containing the sand was revolving while the tar was being introduced and continued to revolve for a short time afterwards. The tar was introduced in less than 1 min. and an additional mixing time of 1½ min. was found to be sufficient to produce a uniform mixture. The temperature of the tar at the time

SCREED is pulled over hand-spread tar-mastic cushion material to evel it off in lanes 18 ft. wide to uniform depth of ¾ in.

PILES of cushion mixture, delivered by transit mixer, are spread by hand shoveling before screeding.

BRICK, with end and side lugs to insure space for penetration of joint filler, are laid on unrolled tar-mastic cushion.

of mixing was 150 deg.F., but the sand was not preheated.

After the cushion course material had been spread by hand it was accurately shaped to proper cross-section ¾ in. thick with a template. The tar-sand mastic was laid in two longitudinal sections, each 18 ft. wide, and was not consolidated by rolling before the brick were laid upon it.

In the tar-sand mastic cushion were bedded vertical-fiber, rough surfaced, de-aired brick, 3 in. deep, 4 in. wide and 8½ in. long. Side and end lugs separated the bricks sufficiently to permit proper penetration of the asphalt filler. The brick surface was rolled with a 5-ton roller and then, prior to the application of the hot asphalt joint filler, was sprayed with an anti-adhesive mixture consisting of 1½ sacks of finishing lime in 50 gal. of water, to which was added 1 per cent, by weight, of laundry starch. This mixture was applied to the brick by hand-operated pressure sprayers to facilitate the removal of the excess joint filler by hand scrapers.

PRESSURE SPRAY *(right)* applies non-adhesive solution to surface of brick to facilitate scraping off excess of asphaltic joint filler.

The asphalt filler, heated to 375 to 400 deg.F., was poured on the brick at the rate of 9½ to 10¼ lb. per square yard. A short time was allowed for the filler to penetrate into the joints and the surplus filler was then removed from the surface by means of scrapers and returned to the heating kettles.

This project was noteworthy because of the methods used for the production and placing of the tar-sand mastic cushion. The use of transit mixers for this purpose is regarded as a decided improvement over previous methods which involved the mixing of the tar and the sand at the project in batch concrete mixers or similar devices.

JOINT FILLER, consisting of hot asphalt, is poured over surface of bedded and rolled lug brick.

SCRAPERS remove from brick surface excess of asphaltic joint filler, which is returned to heating kettles for re-use.

Accurate Concrete Control and Placing Methods

Feature

BITUMINOUS CONCRETE PROJECT

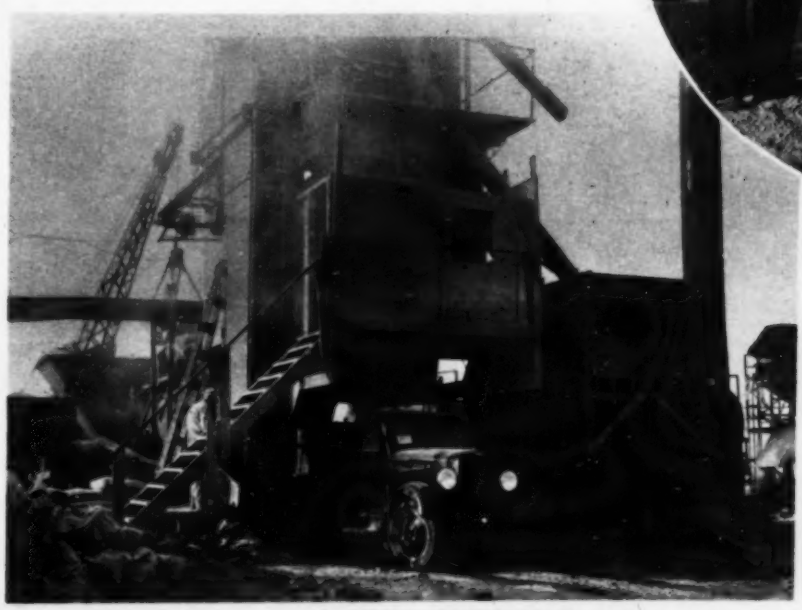
ASPHALT MIXING PLANT equipped with apparatus for accurate control and automatic recording of temperatures produces uniform bituminous concrete batches for Michigan paving project.

WHEN SINGLE TRUCK delivers 5-ton load of asphaltic concrete, it alternates between spreader boxes on two sides of road charging boxes in turn and drawing them forward about 20 ft. at a time. Finishing machine riding on steel forms strikes off binder and surface courses.

MODERN PROPORTIONING, timing and temperature control apparatus required by the Michigan State Highway specifications for 1935 aided the Warren Bros. Roads Co., of Flint, Mich., in producing uniform bituminous concrete mixtures for 4.3 mi. of 3½-2½-3½-in. pavement 20 ft. wide on compacted gravel base between Frankfort and Benzonia, on Route M-55. An asphalt plant was set up adjacent to a dock at Frankfort for boat delivery of sand and crushed rock transported to this point from the opposite side of Lake Michigan. Subgrade of the pavement was trimmed to exact profile on tangent by a tractor-drawn subgrader riding on 9-in. steel forms. A blade grader cut the subgrade on curves, which are superelevated for safe vehicle operation at 50 m.p.h. Concrete for both binder and top courses was distributed between steel edge forms by spreader boxes and was struck off by a self-propelled finishing machine. Pavement smoothness was held to ⅛-in. maximum variation in 10 ft., as required by the specifications.

Design of Pavement—Under its recently completed contract, the Warren Bros. Roads Co. placed a two-course bituminous concrete pavement on a compacted gravel road which had been designed and located several years ago to serve first as a traffic connection between two sections of portland cement concrete pavement and second as a base for paving at a later date, when funds might become available. No changes in location were necessary for the paving project. The road crosses rolling country on grades ranging up to a maximum of 7 per cent. About half the project is in curves averaging 2,000 ft. long and varying in degree of curvature from 12 min. to 2 deg. 36 min. Curves greater than 30 min. are superelevated for vehicle speeds of 50 m.p.h., the superelevation of the sharpest curve amounting to 1.4 ft. On the high side of superelevated curves and at other points where it was necessary to build

SUPERVISING CONSTRUCTION (left to right): D. Evans, chief inspector, and W. G. Draper, engineer, Michigan State Highway Department: and H. Nowatzky, superintendent, Warren Bros. Roads Co.



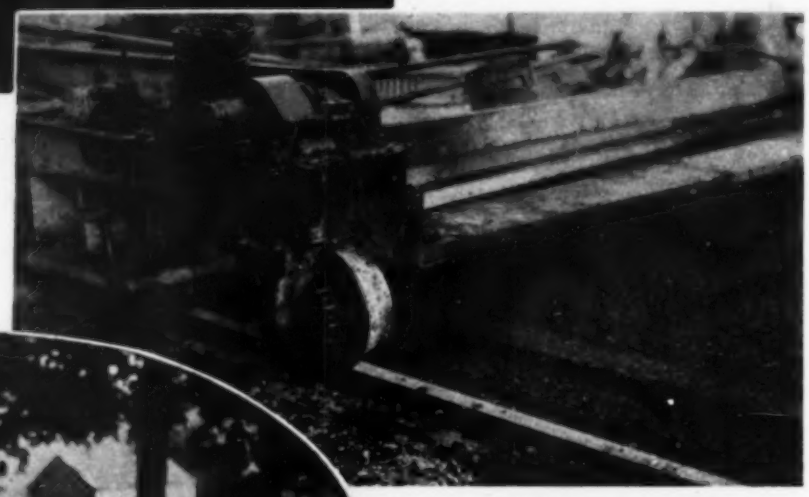
TRUCK BACKS UNDER MIXER at asphalt plant to receive asphaltic concrete batches, delivered to truck body at temperature between 260 and 300 deg., F.

TWO STEAM TANDEM ROLLERS provide desired flexibility and sensitiveness to operator's control for compacting smooth surface on asphaltic concrete pavement.

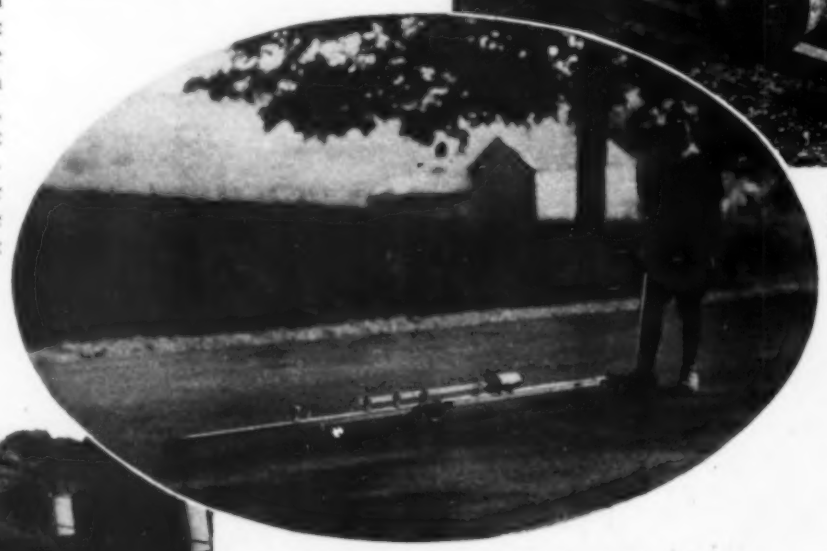
up the original gravel base, the design provided a bituminous concrete wedge course laid in 2-in. compacted layers.

Plans called for a 2½-1½-2½-in. binder course and a 1-in. top course, built to 20-ft. width with a 1½-in. parabolic crown. The 2½-in. edge thickness of binder tapers to 1½-in. in 3 ft. Blades of the subgrader were set to accurate profile 3-2-3 in. below the surface of the completed pavement with the expectation, verified by experience, that the blades would cut somewhat deeper and that the actual binder section would be 2½-1½-2½ in. Prior to placing of the binder course, the gravel subgrade was given a prime coat of asphalt cutback applied by a pressure distributor at the rate of ⅓ gal. per square yard. As indicated by the table of asphaltic mixtures, the top course was designed on the so-called "skip-grading" principle, omitting stone sizes less than ¼ in., to produce a coarse, skid-proof surface texture. On this project the engineers utilized a permissible light top dressing of sand-asphalt filler, spread by hand, to seal voids in the wearing course. The filler was carefully brushed into the interstices to avoid any diminution of the non-skid quality of the surface.

Concrete Mixtures—Crushed graded limestone from Sturgeon Bay, Wis., and clean, sharp sand dredged from the bottom of Lake Michigan were used in base, binder and top mixtures. Proportions of the mixtures are shown in the accompanying table. As indicated, binder was mixed in 2,000-lb. batches, but a 1,500-lb. box was used for top to avoid balling by the limestone filler dust and choking at the discharge end of the worm conveyor which fed this dust into the weighing hopper.



EXTRA MATERIAL to fill depression against edge form is left behind finishing machine by special grooved casting near end of reciprocating screed.



SURFACE TESTER equipped with electric buzzer is adjusted to indicate irregularities greater than ⅛ in.

STEEL EDGE FORMS *(left)* are set to accurate line and grade and tamped firmly in position.

Control Devices — Automatic time locks and optical and recording pyrometers, required by Michigan's 1935 specifications, eliminated all guesswork from control of asphaltic mixtures at the plant. Comprehensive tests of materials, mixtures and completed pavement supplemented this control and assured uniform quality in the finished product. A G.E. time-lock system controlled both dry-mix and wet-mix periods. It was impossible for the operator to dump the asphalt-bucket until a horn signalled the end of the dry-mix period. Similarly, he could not open the mixer gate until a bell indicated the end of the wet-mix period. After the mixer gate had been opened to discharge a mixed batch, the lock on the weigh box gate was released to permit the operator to feed the dry materials into the mixer. Opening of this gate started a control device which kept the asphalt bucket locked until the end of the dry-mix period, indicated by the horn signal. Discharge of the asphalt bucket set a second time control which released the mixer gate at the end of the wet-mix period, when the bell rang. The asphalt plant inspector set the apparatus for the established mixing periods and locked the case in which the adjustment was made. Top concrete was mixed 20 sec. dry and 60 sec. wet, a total of 80 sec. Binder mixing periods were 10 sec. dry and 35 sec. wet, a total of 45 sec.

Aggregates and asphalt were weighed by Howe dial scales, the dry materials being measured on a single dial with pointers set on the circumference to mark the cumulative weights of the various ingredients. Both scales were equipped with beams and counterpoises to balance the tare weight of the boxes.

An electrical recording pyrometer in the plant inspector's office registered on a moving sheet of graph paper the temperatures in the boot of the hot-sand elevator. An optical pyrometer set up beside the cold-sand elevator likewise indicated hot-sand temperatures to the operator who controlled the gates of the sand and stone hopper, enabling him to adjust the feed to hold the hot materials within the specified temperature range of 275 to 375 deg., F. Sand and stone were fed by belt to the cold-sand elevator.

Plant Operation — A crawler crane handling a ¾-yd. clamshell bucket on a 40-ft. boom unloaded sand and stone from a boat to stockpiles. From the stockpiles, these materials were transferred by the crane to a two-compartment steel hopper feeding the cold-sand elevator. Asphalt was received in tank cars and was pumped about 250 ft. to a storage tank and thence to two 1,500-gal. kettles where the temperature was raised to 350 deg. for mixing. A 125-hp. horizontal boiler supplied steam for heating the asphalt and driving three pumps, two of which took care of the asphalt while the third delivered oil from tank cars for the burners in the dryer.

Screens, bins, mixer, dryer and dust collector were of Warren Bros. design and construction. The plant had a capacity, governed by the dryer 18 ft. long

Bituminous Mixtures by Weight

Top Mixture

	Per Cent	1,500-lb. Batch
Stone, ¼-in. to ½-in.	10.0	150 lb.
Stone, ½-in. to ¼-in.	45.0	675 lb.
Sand	32.6	489 lb.
Limestone dust	6.6	99 lb.
Asphalt	5.8-5.9	87-89 lb.

Binder Mixture

	Per Cent	2,000-lb. Batch
Stone, 1¼-in. to ½-in.	36.5	730 lb.
Stone, ½-in. to 10-mesh	36.5	730 lb.
Sand	22.0	440 lb.
Asphalt	5.0	100 lb.

Wedge Mixture

	Per Cent	2,000-lb. Batch
Stone, 1¼-in. to ½-in.	32.25	645 lb.
Stone, ½-in. to 10-mesh	32.25	645 lb.
Sand	30.0	600 lb.
Asphalt	5.5	110 lb.

and equipped with double burners, of 40 tons an hour. The hot-sand elevator fed materials to rotary screens above four-compartment steel overhead bins which were equipped with overflows to prevent mixing of the aggregates. Limestone filler dust for the top mixture was received by rail and was stored in a closed compartment alongside the bins. Dust collected from the dryer was wasted. A 75-hp. motor drove the dryer, fans, screens, elevators and conveyors.

Subgrade—Except on superelevated curves, the contractor used a Lakewood subgrader drawn by a motor grader to prepare the fine grade for the pavement, setting 9-in. steel road forms in advance to serve as a track for the subgrader. The tops of these forms were set accurately to the grade of the finished pavement, as marked by grade stakes at 25-ft. intervals on both sides of the road. Blades of the subgrader were adjusted to cut 3 in. below the surface of the completed pavement.

At superelevated curves, where 9-in. forms were not deep enough to be used on the high side, the motor grader cut the gravel to shallow depth on the low side and built up the high side. Where the depth on the high side was excessive, it was built up later with layers of binder mixture. Fine grade was held to ¼-in. maximum variation, a string check being made at intervals of 25 ft. or oftener both by the grading foreman and by inspectors who followed him.

Pavement Construction—A fleet of four to six rented trucks transported 5-ton loads of asphaltic concrete from the plant to the road. Length of haul varied from 2 mi. at the near end of the project to 6½ mi. at the far end. Binder and top mixtures were placed in the trucks at temperatures ranging from 260 to 300 deg. F., and were dumped into the spreader boxes at temperatures between 225 and 275 deg. F.

A pair of skid-mounted Adams spreader boxes, each about 9 ft. wide, distributed the hot mixtures on the two halves of the 20-ft. pavement between steel road forms. Unless two trucks were present to pull the boxes forward simultaneously, a single truck alternated between the two, dumping into each in turn and pulling it forward about 20 ft. An Ord finishing machine following close behind the spreaders struck off both binder and top courses The machine traveled on 3½x6-in. Blaw-Knox forms, of which the contractor had 4,000 lin. ft. on the job. When placing top course, the screed rode on compression dollies and was equipped near each end with a special grooved casting which left a shallow ridge of asphaltic concrete behind the machine for the rakers to fill the edge against the forms. This device saved the labor of two men ordinarily employed in carrying back material from in front of the screed to the rakers.

A 10-ton three-wheel roller performed the longitudinal rolling behind the screed machine, and two 8-ton tandem rollers were used for the longitudinal and diagonal rolling. The binder course was checked with a 10-ft. straight-edge, and the top course both by the straight-edge and a Cambridge surface tester set for ⅛-in. variation in 10 ft. The surface tester was made of Dow metal for light weight and folded at the center for ease in carrying. It was equipped with an electric bell operated by dry cell to indicate irregularities exceeding the established limit.

Bitumen Tests—In addition to ordinary tests of materials and mixtures to determine the quality and amount of aggregates and asphalt cement present, the Michigan State Highway Department made a recovery test on the bitumen from the pavement itself, after it had been laid and cooled, to determine the loss in penetration and ductility of the asphalt cement. From extensive research work with the extracted bitumen from old pavements throughout the state, the Department has found that the life of a properly designed asphalt pavement is almost entirely dependent upon the amount of the original penetration and ductility of the asphalt (in a mass) which is retained after being subjected to the heating and mixing (as a film) during the processes of manufacture, hauling, and laying of the mixture. This new test, called the "Extracted Bitumen Test," was conceived and developed last winter by V. B. Steinbaugh, deputy commissioner and road engineer, using the extraction method of Gene Abson. Laboratory procedure for the test was perfected by J. W. Kushing, head of the Division of Research and Testing. The test, which received the approval of the U. S. Bureau of Public Roads for 1935, apparently fulfills entirely the requirements of a service test for asphalt. On every bituminous construction project in the state, samples of both the top course and the binder course are taken at the beginning and end of each tank car and sent to the laboratory at Ann Arbor for the recovery test. The Highway Department intends to make similar tests annually on each bituminous project in the state to determine the further annual loss in penetration and ductility.

Progress—Grading of the project started Aug. 23, 1935, and the first binder was laid Sept. 9. A completion date of Dec. 15 was set by the contract, but the contractor completed the paving on Oct. 17 and finished the shoulders, involving 2,275 cu. yd. (original estimate) of borrow on Oct. 30.

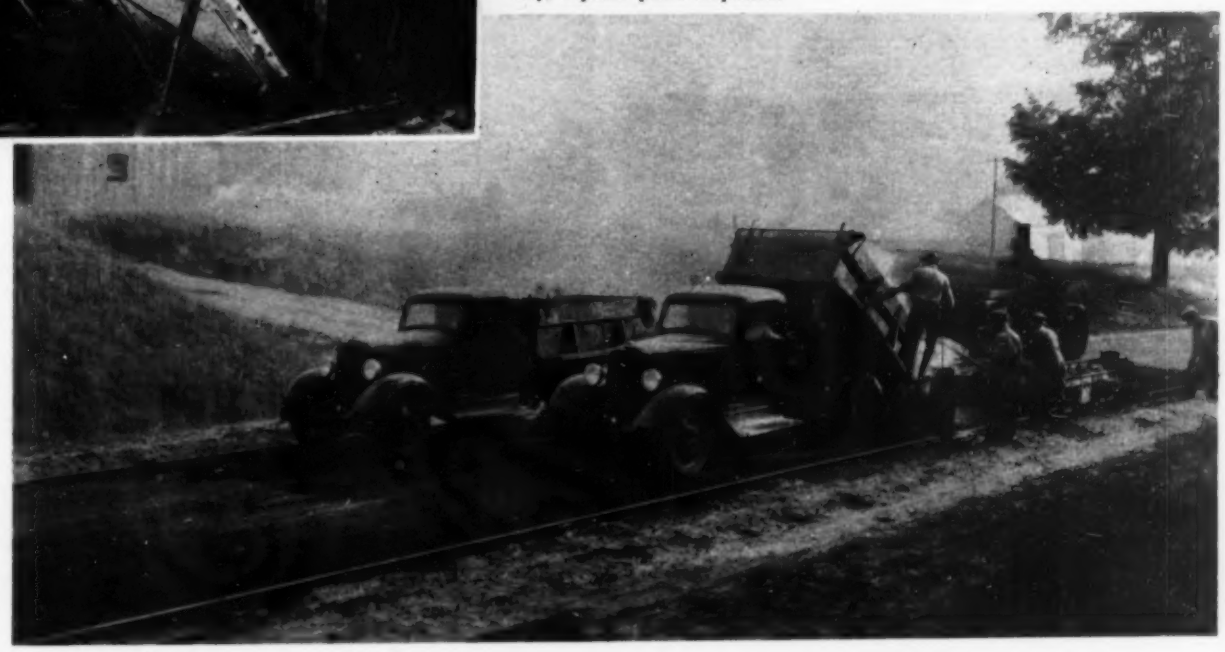
As the project was built with federal aid but was not financed with National Recovery or Work-Relief funds, the contractor was permitted to employ workmen 40 hr. a week. Two shifts totalling 93 men were employed, and the organization worked a full week of six 12-hr. days. On no day did the job take the full capacity of the asphalt plant, but on several occasions the production approached this limit. For example, on Sept. 20, the paving crew laid 451 tons of material in 1,700 lin. ft. of binder course and 650 lin. ft. of top course.

Personnel—Murray D. Van Wagoner is Michigan state highway commissioner, Harry C. Coons is deputy commissioner-chief engineer, and V. B. Steinbaugh is deputy commissioner-road engineer. Under the general direction of E. G. Schwoppe, district engineer. Cadillac, the Frankfort-Benzonia project was in the charge of J. T La Due, project engineer, assisted by W. G. Draper.

For the Warren Bros. Roads Co., of Flint, Mich., contractor, H. J. Noonan is general superintendent. Operations on the project were directed by H. Nowatzky, superintendent.

IN CHARGE of asphalt plant. Dale M. Morgan *(left)* plant foreman, and Frank B. Markey, asphalt plant inspector.

TWO spreader boxes distribute asphaltic concrete for binder and top courses between steel edge forms.



TWO TRUCKS deliver hot mixture simultaneously to pair of spreader boxes. Finishing machine and roller operate close to spreading equipment.

Pavers and Truck Mixers Build

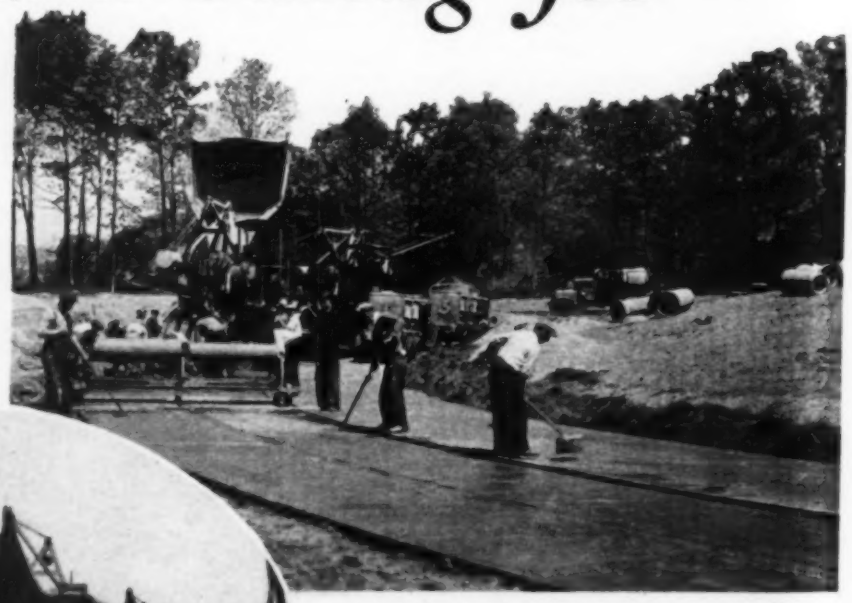
TANDEM PAVERS operating on subgrade outside forms of first 11-ft. lane mix and place 7-in. base of 9-in. sheet-concrete pavement. Truck mixer on berm ground delivers dark-colored concrete for 2nd lane. Batch trucks and truck mixers travel on steel plates laid on sandy soil.

DARK-SURFACE SHEET CONCRETE

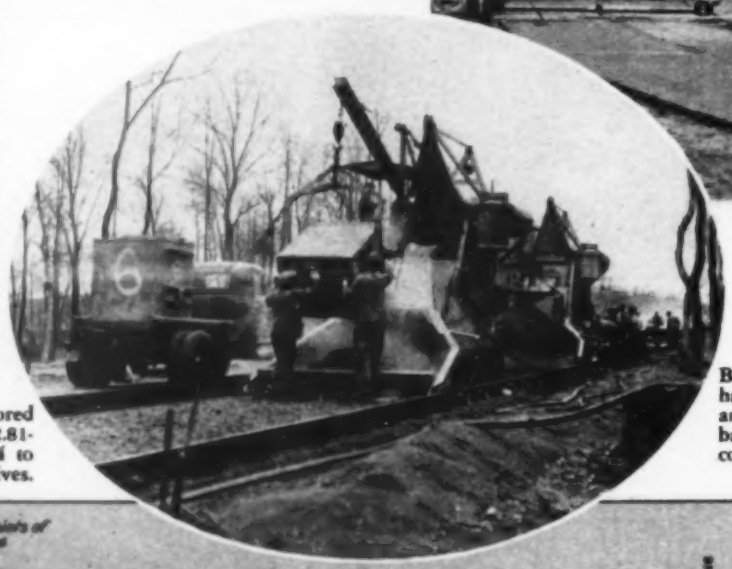
on High-Production Paving Job

OF TWO OPTIONS offered the contractor for 100,500 sq.yd. of dark-surface concrete pavement on a 2.81-mi. section of the Meadowbrook Parkway, constructed as a combination NRH and NRM project by the New York State Department of Public Works for the Long Island State Park Commission, the Tuckahoe Construction Co., Inc., of Tuckahoe, N.Y., low bidder at a price of about $407,000 ($22,000 below the next bidder), on the basis of previous experience with both types of pavement, chose 9-in. sheet concrete in preference to 8-in. reinforced slab. A contract for the paving was approved on April 5, 1935. Specifications required that the contractor place sufficient equipment on the project to complete the entire pavement and open it to traffic for the holiday crowds on May 30. This requirement was interpreted by the engineers in charge to call for four 27-E paving mixers or equal. A final date of July 1 was set by the contract for completion of the entire project, including supplemental structures, top-soiling and seeding.

As a result of favorable experience with sheet concrete on two prior contracts in another part of New York State (Westchester County), the Tuckahoe Construction Co. elected for the third time to build sheet-concrete pavement on this project, using paving mix-

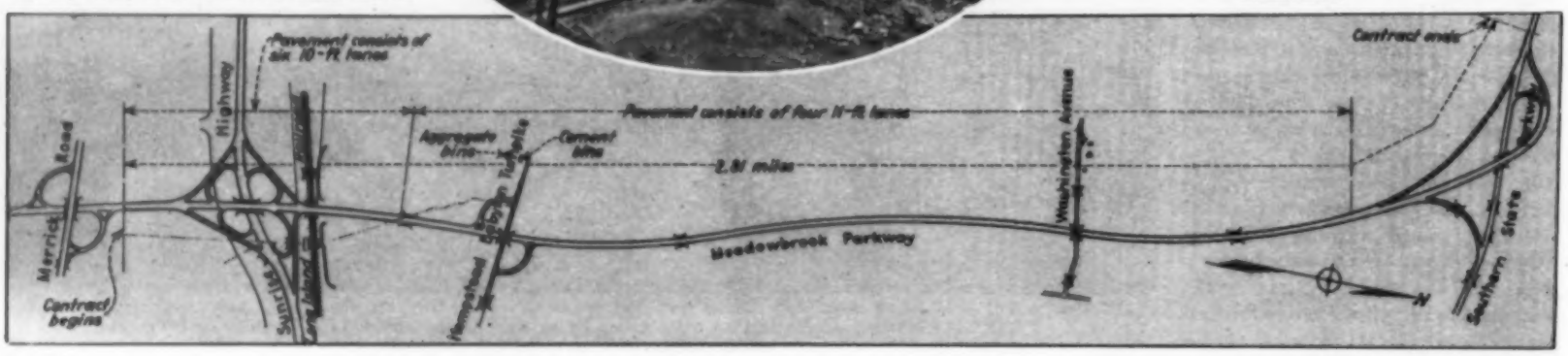


IN CONSTRUCTING TWO-LANE ACCESS ROAD, batch trucks traveling on completed first lane deliver dry materials to tandem pavers operating on subgrade of second lane. Single paver ordinarily builds base on access roads.



100,000 SQ. YD. *(below)* of dark-colored sheet-concrete pavement is involved in 2.81-mi. project calling for main roadway 44 to 63 ft., wide, with numerous access drives.

BATCH BOXES *(left)* are used so long as trucks haul on steel-plate track to pavers building first and second lanes. Contractor changes to four-batch end-dump trucks when mixers travel on completed pavement in building third and fourth traffic lanes.

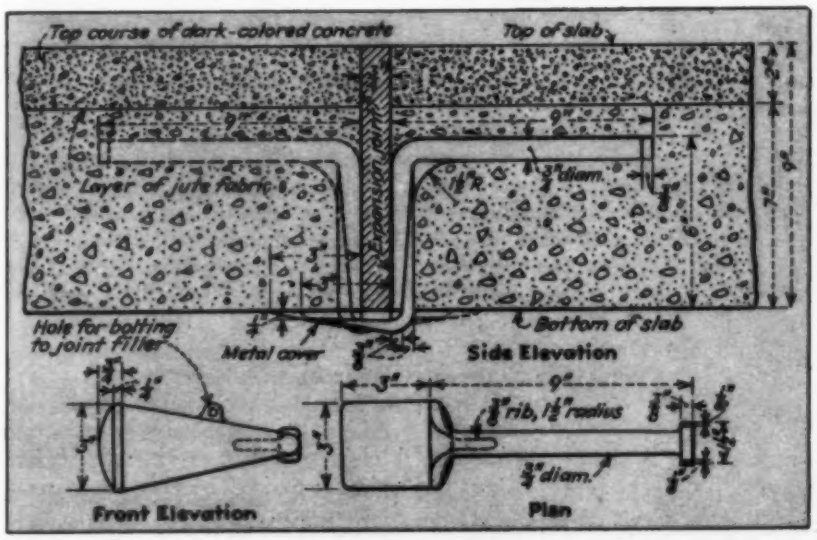


ers to place the 7-in. base course and truck mixers to lay the 2-in. top course. In New York State, the sheet-concrete design calls for 1:2½:5 concrete in the 7-in. base and 1:1½:2½ concrete in the 2-in. top course, with a layer of coarse-mesh jute fabric between the two concrete courses. The 8-in. reinforced slab requires a uniform 1:1¾:3½ mixture.

Various combinations of paving equipment were utilized by the contractor at different stages in the construction of the highway. At the start of paving operations, the concrete-producing plant consisted of two Foote 27-E paving mixers, operated in tandem, and three truck mixers, two 3-yd. units and one 2-yd. unit. This plant was expanded to full capacity by adding a third Foote 27-E paver and by enlarging the truck-mixer fleet to five 3-yd units, four Jaegers and one Rex. With the exception of access roads at intersections the contract called for construction of pavement four to six lanes wide.

Because of the extremely sandy character of the soil, the contractor in building the first two lanes used a steel-plate track for batch trucks and truck-mixers. With this single-track hauling arrangement, the original concrete plant consisting of two paving mixers in tandem and three truck-mixers placed up to

EXPANSION JOINT *(upper right)* **designed to prevent slab settlement incorporates cast-steel brackets which are attached to cork filler in pairs with shanks turned in opposite directions** *(right)* **when joint is assembled on job. With shanks embedded in concrete** *(below)* **steps, or shelf angles, on brackets support abutting slabs. Metal covers on shelf angles prevent bonding of concrete to supports and provide for movement of slabs.**



648 cu.yd. of concrete in a 10-hr. day. When the concrete plant had been augmented to final capacity by the addition of another paver and several 3-yd. truck mixers, daily production increased to a maximum of 962 cu.yd.

Description of Project—Under the Tuckahoe contract, the Long Island State Park Commission, owner of the right-of-way, extended the Meadowbrook Parkway north from Merrick Road 2.8 mi. to a connection with the Southern State Parkway. As shown by an accompanying plan, intersections of the Meadowbrook Parkway with the Sunrise Highway, with the Hempstead-Babylon Turnpike, and with the Southern State Parkway are treated as full cloverleaf or modified cloverleaf grade separations. These intersections account for the large volume of concrete, about 25,000 sq.yd., involved in access roads. Bridges for the three grade separations mentioned, as well as for a fourth intersecting road at Washington Ave., North Merrick, and for an overcrossing above the Long Island Railroad tracks had been completed under earlier contracts. Fill for the 2.81 mi. of concrete pavement also had been placed under separate contract during the winter and spring of 1935.

For about ½ mi. north of Sta. 0.0, at the south end of the project, the pavement consists of six 10-ft. lanes divided into two groups of three lanes each by a low center island 3 ft. wide, making the total width of concrete 63 ft. This portion of the project includes the grade separation at the intersection with the Sunrise highway and the bridge over the Long Island Railroad tracks. North of Sta. 26 the pavement reduces to four 11-ft. lanes (without any center island), giving a total width of 44 ft. for the normal pavement section. Access roads are principally 20 ft. wide, although a few have widths of 22 ft. and 30 ft.

Joint Supports—In an effort to eliminate settlement at expansion joints, which are spaced an average distance of 92 ft. apart, the designing engineers incorporated special cast-steel supports in the abutting slabs for transfer of loads across the joints. An accompanying drawing and several photographs show the design of the joint supports and the method of attaching them to a strip of premolded cork filler. As indicated by the drawing, a 9-in. shank of the support is embedded in one slab. This shank supports a step, or shoe, upon which the other slab rests. A metal cover prevents the shoe from bonding to the second slab and leaves ample space for movement as the slabs expand. The supports are installed in pairs, with the shanks embedded in alternate slabs. For a 10-ft. lane, the design called for five pairs of supports. Including cork filler, the materials for an 11-ft. joint cost about $7.37.

Construction Plan — New York State requires that concrete pavement be built in single lanes, with a construction joint between adjacent strips. To obtain maximum production at lowest cost on a single-lane construction of the main highway, the contractor utilized two paving mixers in combination. For the first two lanes, where the paving mixers ran on the subgrade inside the forms, it was necessary to operate the two units in tandem, with each batch passing through both drums for a required total mixing time of 75 sec. After the first two lanes had been completed, the two mixers ran on the pavement and operated boom-to-boom in building the third lane. For the fourth lane, the contractor returned to the tandem arrangement as more satisfactory for placing the 7-in. base course of sheet-concrete pavement.

When operating the two pavers in tandem between the forms of each of the first two lanes, the contractor kept the batch trucks off the subgrade by delivering dry materials in batch boxes which were swung over the mixer skip by a boom hoist. A track for the batch trucks and truck mixers in the soft sand outside the forms was paved with 300 tons of steel plates weighing 350 lb. each. Concrete slab could be opened to traffic under the specifications 12 days after being placed. In the construction of the third and fourth lanes the contractor utilized the completed pavement to carry both paving mixers and hauling equipment.

Under subcontract the Colonial Sand & Stone Co. supplied batched aggre-

DARK-COLORED TOP MIXTURE containing emulsified carbon black is delivered to 11-ft. lane by 3-yd. truck mixer which travels parallel with pavement. Concrete is spread with hand rakes and struck off with mechanical finisher.

MANUAL TAMPING compacts 7-in. base prior to application of coarse-mesh jute fabric separating two concrete layers.

STEEL TEMPLET riding on edge forms is drawn forward by paving mixer to strike off concrete for 7-in. base.

CONTRACTOR BROTHERS: Joseph J. Luciano *(left)*, secretary, and Dominic Luciano, president, Tuckahoe Construction Co., Inc.

gates and truck-mixed concrete to the job, taking care of all batching operations and furnishing four-batch trucks for hauling to the paving mixers when the pavers were traveling on concrete. As indicated on the accompanying plan, a batching plant was set up on the Hempstead-Babylon turnpike near this road's intersection with the Meadowbrook Parkway. The plant consisted of two aggregate batchers and two cement batchers. One aggregate batching set-up weighed out sand and two grades of crushed rock for the paving mixers and the other unit supplied sand and one size of stone to the truck mixers. Both cement batchers weighed out five-bag charges which could be delivered to either batch trucks or truck mixers.

Dark-Colored Concrete—To eliminate glare from the surface of the concrete pavement, the specifications required that the 2-in. top course be given a dark color by adding to the cement 3 per cent by weight of emulsified carbon black. The carbon emulsion was dumped into the open hatch of the truck mixers at the batching plant as they were being charged with sand and stone. The addition of the carbon black had no apparent effect on the consistency, workability, setting, hardening or strength of the top-course concrete. When placed on the base concrete, the mixture for the top course had a black color which changed to a final dark gray as the concrete set and hardened.

Paving Procedure—For the construction of the first lane, the contractor laid a steel-plate track the entire length of the project. On its initial run the paving crew completed this lane to a point near the intersection with the Southern State Parkway, where a bridge contract was in progress. The tandem pavers then returned to the south end to start construction of the second lane. A steel-plate track was used again in delivering dry batches and transit-mixed concrete for the second lane.

Batchmeters of the tandem mixers were set for 45 sec. on the first unit and 30 sec. on the second unit, providing a margin for the first paver to handle batch boxes. A fleet of eight two-batch trucks hauled batch boxes to the pavers. Occasional delays in delivery of batches resulted from blockades of the single-track transportation system while truck-mixers distributed 3-yd. loads of concrete to the top course.

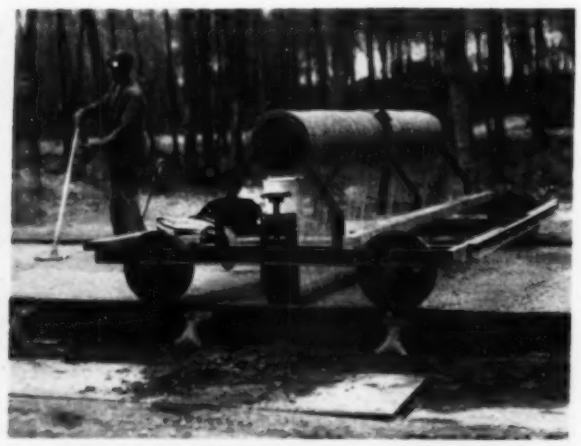
A third 27-E paver built the remaining four lanes of a total six-lane width between Sta. 0.0. and Sta. 26, at the south end of the project. This paver traveled on the subgrade inside the forms and received materials in batch boxes delivered by trucks traveling on the completed pavement. The third paving mixer then concentrated on access roads.

For the construction of the third 11-ft. lane from Sta. 26 north, the contractors delivered dry batches with a maximum of seven four-batch trucks to two 27-E pavers operating boom-to-boom on the pavement. For the fourth lane they resumed tandem-paver operation.

Concrete Production—Daily records of concrete production varied in accordance with the number of units in operation. Although the full working day was 10 hr., ordinary delays and interruptions frequently reduced the number of paving hours considerably below this figure. For the period of 25 working days in which the contractor operated two paving mixers in tandem and three truck mixers (two of 3-yd. capacity and one of 2-yd. capacity), the average concrete production per day was 390 cu.yd. During this period operations were in progress for 210 hr., and the actual production per paving hour was 46½ cu.yd.

In addition to the paving on the main highway and on access roads, the contractor had 10 mi. of 15-in. concrete curbs to build throughout the contract. When the truck-mixer fleet had been expanded to five 3-yd. units, it was customary to use one of these truck mixers in hauling concrete for curbs. After the concrete producing plant had

STEEL-PLATE TRACK parallel with pavement carries truck mixers and batch trucks hauling materials for two courses of sheet-concrete pavement. Jute fabric is unreeled from twin rolls mounted on mobile carriage.



COARSE-MESH FABRIC unwound from rolls on carriage is pressed into top of base with flat iron on long handle.

CONTRACTION JOINT 1/8 in. wide and 1½ in. deep is constructed between expansion joints. Note texture of broomed dark surface.

SPECIAL GROOVING TOOL cuts contraction joints in pavement surface to develop planes of weakness at specified intervals.

been enlarged to include the third paving mixer and five 3-yd. truck mixers, the combination of all these units placed 9,802 cu.yd. in 14 working days, an average production of 700 yd. per day. During this stage of operations it frequently happened that one or more of the units would be idle while the others were working. Without making allowance for these partial shutdowns, the total number of paving hours in the second stage of construction was 126½ hr. Dividing the total production by this number of hours, the average production of the full-capacity plant may be set down as 77½ cu.yd. per hr.

For the entire job, regardless of the number of units operated, the average concrete production per working day was 411 cu.yd., and the average production per paving hour was 49½ cu.yd. As examples of production obtained on typical days when paving delays were neither numerous nor long, the contractor on April 23 placed 564 cu.yd. with two pavers in tandem and three truck mixers and on May 20 placed 889 cu.yd. with three paving mixers and five truck mixers. On May 21, with the latter equipment in operation, production amounted to 919 cu.yd. As already stated, the maximum daily production was 962 cu.yd.

Batching Plant — Concrete for the base course was designed on volume proportions of about 1:2½:5. The coarse aggregate was made up of three sizes of crushed trap rock, ranging from ⅜ in. to 2¼ in. Basic dry weights per sack of cement were 294 lb. of sand and 470 lb. of stone. Concrete was mixed in five-bag batches. Actual weights, with allowance for moisture, used on a typical day at the batching plant were 1,557 lb. of sand, 1,057 of No. 1 and No. 2 (small) stone, and 1,292 lb. of No. 3A (large) stone, to which was added 470 lb. of cement.

Design of the top course was based on volume proportions of about 1:1½:2½, and the basic dry weights of aggregate per sack of cement were 160 lb. of sand and 212 lb. of crushed trap rock. The rock ranged in size from ⅜ in. to ⅝ in. For convenience, the top mixture likewise was measured out in five-bag batches, each 3-yd. truck mixer being charged with five batches. The actual weights of materials for a five-bag batch on a typical day were 848 lb. of sand and 1,060 lb. of stone.

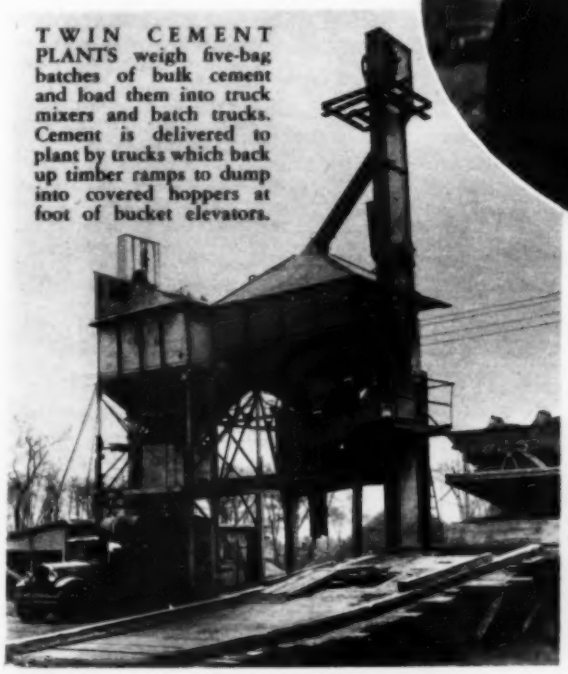
Bulk cement and aggregates were delivered to the batching plant by trucks. The two cement bins were set up near the highway. Covered end-dump cement trucks backed up short timber ramps and discharged their loads into receiving hoppers from which the cement was taken away by spiral conveyors and raised to overhead bins by bucket elevators. A pair of aggregate bins was erected about 150 ft. from the cement-batching set-up. Stockpiles of sand and three sizes of stone were arranged around the rear of the two aggregate bins in such a way as to permit one long-boom crane to handle materials for the two units. A second clamshell crane was kept at the site to transfer the truck-delivered aggregates from the dumping points to stockpiles within reach of the first crane.

Because of the stockpile arrangement behind the aggregate bins, it was necessary for both batch trucks and truck mixers to back under the weighing hoppers. The vehicles drove straight through the cement bins on their way out of the plant. Stop watch studies indicated that it took 3 to 4 min. to load a two-batch truck with aggregates and cement. Including more than 2 min. consumed in removing and replacing the cover, a 3-yd. truck mixer was completely charged with five five-bag batches in 8 or 9 min.

Personnel — Under the general direction of J. J. Darcy, district engineer, Babylon, Long Island, the construction of the Meadowbrook Parkway was supervised for the New York State Department of Public Works by E. W. Dayton, civil engineer in charge of the project. Operations of the Tuckahoe Construction Co. were directed by Dominic Luciano, president; Joseph J. Luciano, secretary; and C. A. Nelson, superintendent.

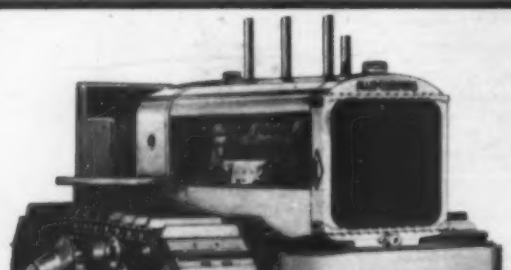
HIGHWAY BUILDERS. *(Below, left to right)*, E. W. Dayton, engineer for New York State Department of Public Works; Joseph J. Luciano, secretary of contracting firm; and C. A. Nelson, superintendent.

TWIN CEMENT PLANTS weigh five-bag batches of bulk cement and load them into truck mixers and batch trucks. Cement is delivered to plant by trucks which back up timber ramps to dump into covered hoppers at foot of bucket elevators.

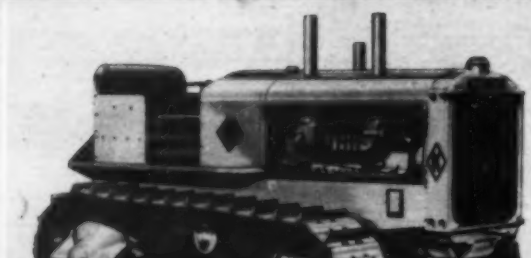


DUAL AGGREGATE PLANTS batch materials for 7-in. base and 2-in. surface. Plant at left weighs sand and two sizes of stone for batch trucks; unit at right measures sand and stone for truck mixers.

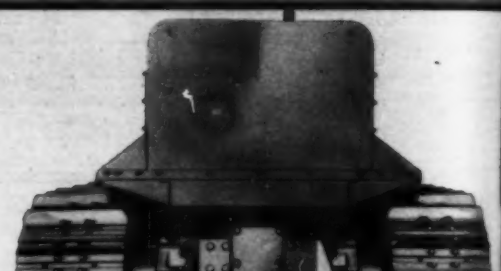
PRESENTING THE ALLIS-CHALMERS LINE OF TRACTORS AND ROAD MACHINERY for 1936



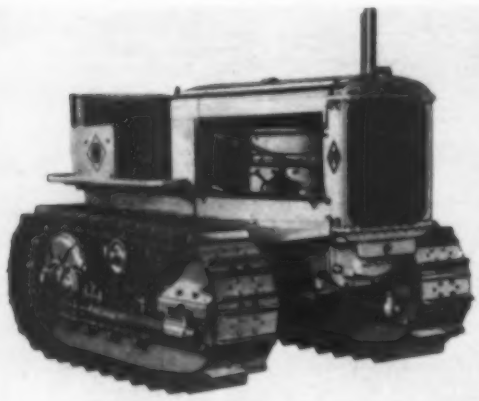
MODELS "L-O" AND "L" OIL & GAS TRACTORS



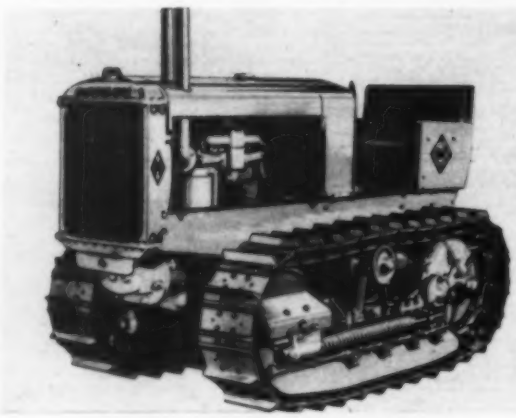
MODELS "K-O" AND "K" OIL & GAS TRACTORS



MODEL "WK" AND "WK-O" — WIDE TREAD

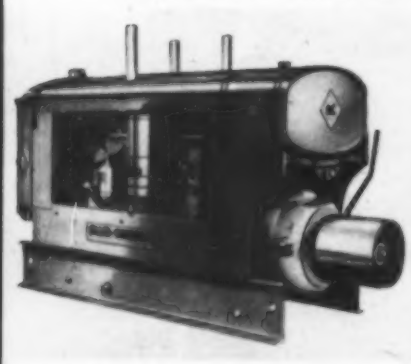


MODEL "WM" — WIDE TREAD

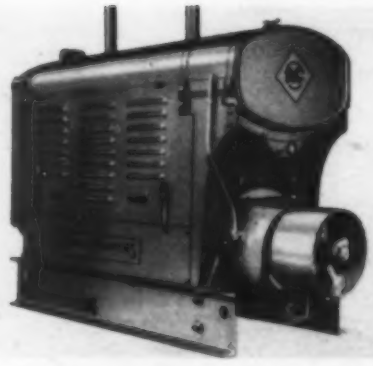


MODEL "M" — STANDARD TREAD

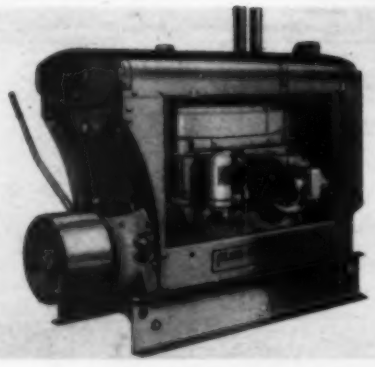
MODEL "IU" INDUSTRIAL TRACTOR



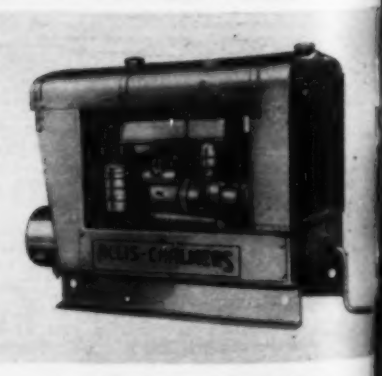
MODEL L-90 POWER UNIT



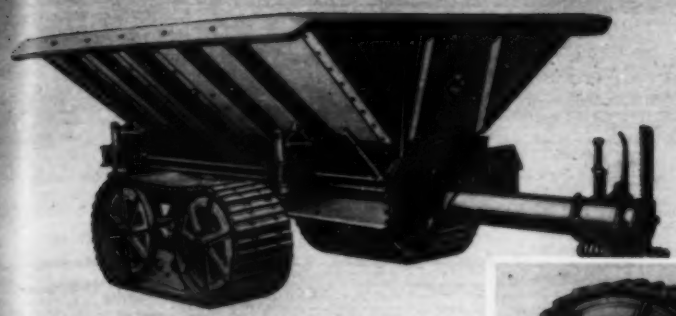
MODEL E-60 POWER UNIT



MODEL U-40 POWER UNIT

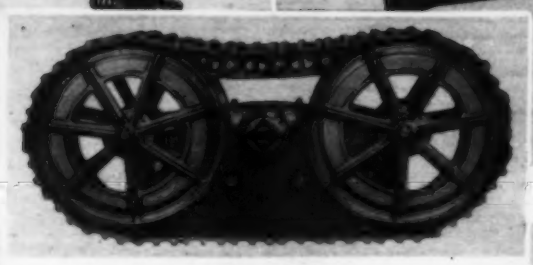


MODEL W-25 POWER UNIT



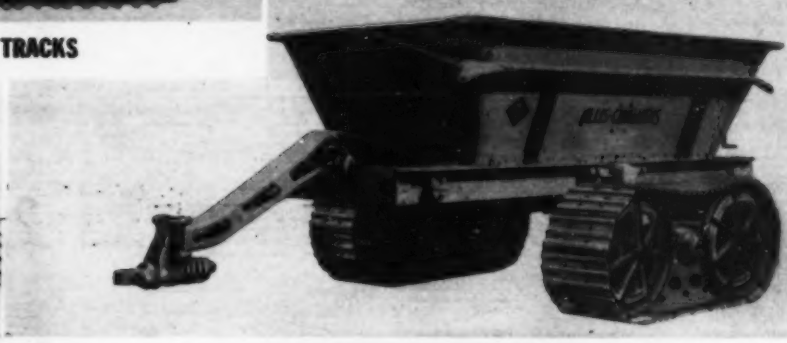
11 AND 15-YARD 2-WAY WAGON

8-YARD GRAVITY DUMP WAGON

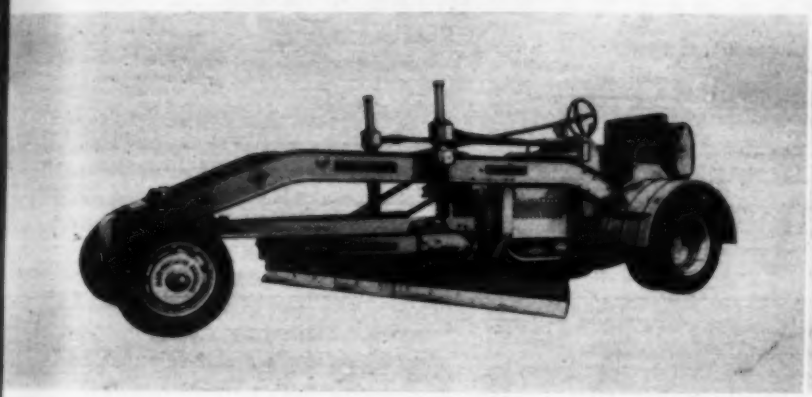


WAGON TRACKS

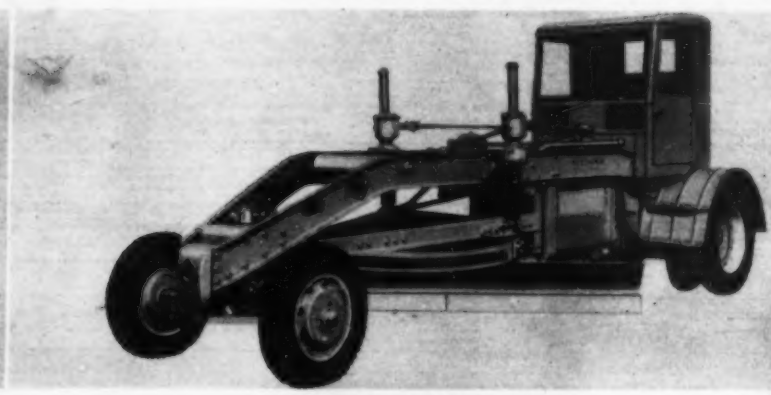
MODEL "K-T" HAULING UNIT



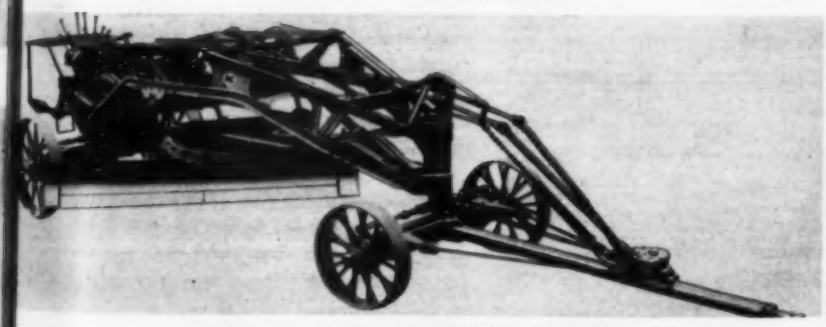
5½-6 AND 7-8 YARD WAGON



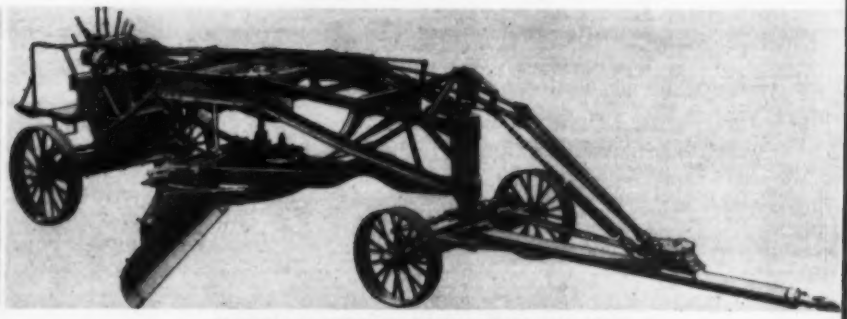
MODEL 42 SPEED PATROL



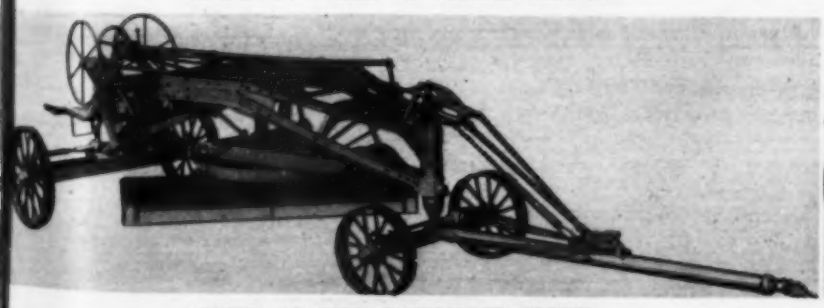
MODEL 54 SPEED PATROL



MODEL 14 POWER CONTROLLED GRADER



MODEL 12 POWER CONTROLLED GRADER



MODEL 10 HAND CONTROLLED GRADER

MODEL 8 HAND CONTROLLED GRADER

To those who are more interested in value and performance than in tradition . . . Allis-Chalmers presents its new and better line for 1936. The cost-cutting Models "L" and "L-O" with a new range of speeds. A new model "K" Series with four speeds forward—up to 5.92 miles per hour . . . with 49.58 Drawbar H.P. . . . and new, convenient controls. A new, Model "K-T" Hauling Unit . . . hauls 6 to 8-yard loads from 2½ to 16 miles per hour. An improved line of blade graders and Speed Patrols. An entirely new line of power units. A line of Oil Tractors that operate on Diesel Fuel with the advantage of gasoline engine simplicity. Get more for your money in 1936—investigate the A-C line before you buy.

ALLIS-CHALMERS TRACTOR DIVISION, MILWAUKEE, U.S.A.

FLEET of 35 BUSES transports relief workers to and from Belt Line highway job.

Minnesota Handles 2,000,000 Cu. Yd.

WORK RELIEF GRADING PROJECT

PROBABLY the largest work relief grading project undertaken by state highway and relief authorities in the United States is Minnesota trunk highway No. 100, the so-called West Belt Line, skirting the city of Minneapolis and calling for 1,911,000 cu. yd. of excavation in a length of 6.6 mi. This highway, along the westerly boundary limits of the city, crosses nine main arterial streets and highways. The traffic of two-thirds of the area of the entire state converging upon the Twin Cities through an enlarged quadrant from the southwest to the northwest will, upon completion of this project, be able to choose the shortest and most convenient entrance into the city, or by-pass the urban area entirely, if so desired.

The completed project will provide five railway grade separations and two arterial highway separations of the clover leaf type. Each highway separation requires the moving of more than 400,000 cu.yd. of material. A minimum width of 60 ft. of traffic roadway, with parallel service drives, is being constructed on a 200-ft., or greater, width of right-of-way.

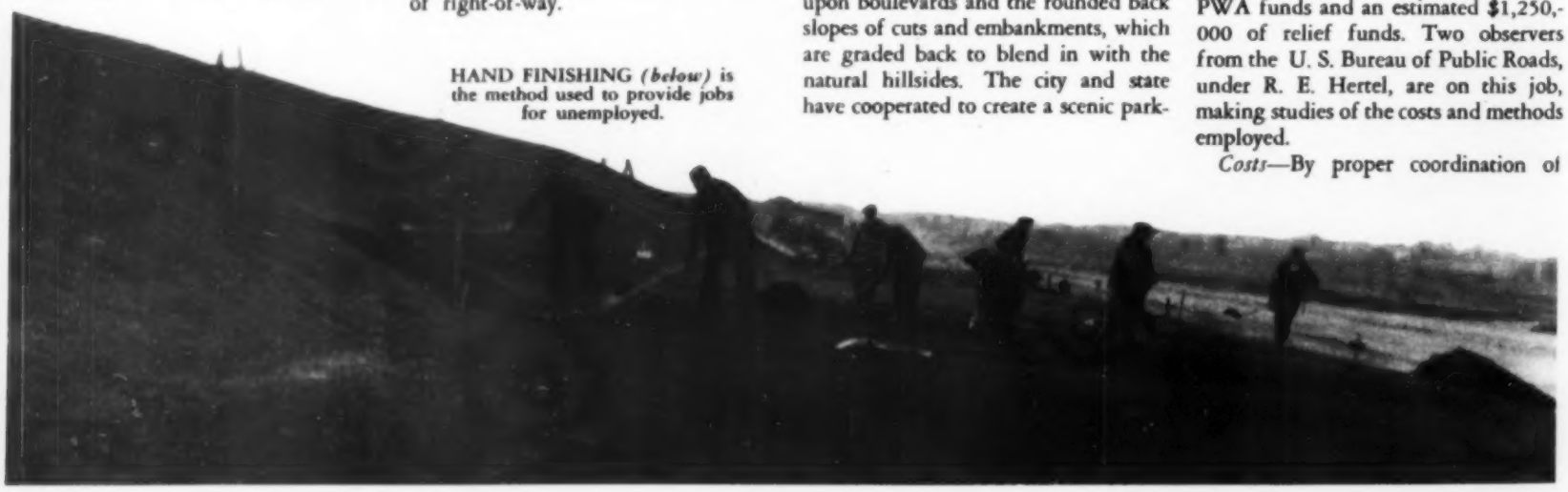
SLOPES are finished by hand labor and covered with black loam for subsequent seeding.

Approximately 40 per cent of the nearly two million cubic yards of excavation had been moved up to last month. Thousands of yards of top soil have been stock-piled or already spread upon boulevards and the rounded back slopes of cuts and embankments, which are graded back to blend in with the natural hillsides. The city and state have cooperated to create a scenic parkway combining natural beauty and landscaping development. An accentuation of lilac planting has already named this the Lilac Highway. The terrain is mostly hills and hollows with several deep swamps adding to construction difficulties.

At first utilized as a work project upon which to place homeless men by L. P. Zimmerman, administrator of the Minnesota State Emergency Relief Administration, with the cooperation of Fred Paul, city engineer, the project was started by hand-labor methods employing 500 to 600 men. In January, 1935, through the cooperation of the above men and N. W. Elsberg, Commissioner of Highways for Minnesota, this project was taken over as an NRWR activity with an allotment of $148,000 of PWA money to meet $565,000 of relief funds. Later the project was increased to the described length and design, which will utilize about $350,000 of PWA funds and an estimated $1,250,000 of relief funds. Two observers from the U. S. Bureau of Public Roads, under R. E. Hertel, are on this job, making studies of the costs and methods employed.

Costs—By proper coordination of

HAND FINISHING *(below)* is the method used to provide jobs for unemployed.



MANY JOBS are created by the loading of trucks with hand shovels.

power-excavating equipment, consisting of two power shovels and a dragline, with truck fleets for hauling, together with hand loading into trucks and some wheelbarrow gangs, the following progressive improvement in efficiency and cost per cubic yard was obtained:

Operating strictly as a hand-labor activity, January, 1935, costs per cubic yard were: Excavation of frozen clay, $7.50; excavation of frozen gravel, $2.75; average for all excavation, $5.10.

By introducing power excavation equipment, in addition to hand-loading methods, the costs per cubic yard, including all materials, culverts, etc., transportation of men and overhead charges, soil selection and landscape finishing were as follows: January, 1935, (latter part), $3.18; February, $2.10; March, $1.25; April, $0.88; May, $0.81; June $0.87; July, $0.67.

During this period from 550 to 800 relief workers were employed every day and from 50 to 90, 1½-ton dump trucks. Thirty-five passenger buses, were required to transport the men to and from the loop district of the city. A new assignment of men was made every week, the relief worker being employed one week in every four. About 3,000 men were given work every month.

By the three methods of operation employed the following costs per cubic yard, which include haul and double handling of much selected material, also indicate a continued improvement:

Month 1935	Power Shovel & Trucks	Hand loading into trucks	Hand loading into wheelbarrows
May	$0.39	$0.98	$1.77
June	0.42	0.77	1.85
July	0.37	0.98	1.15
Aug.	0.26	0.95	

In early August this project was practically closed as a state relief project. In November it was resumed as a WPA work relief project through Victor Christgau, state administrator of the Works Progress Administration About 2,000 men are to be assigned to this job.

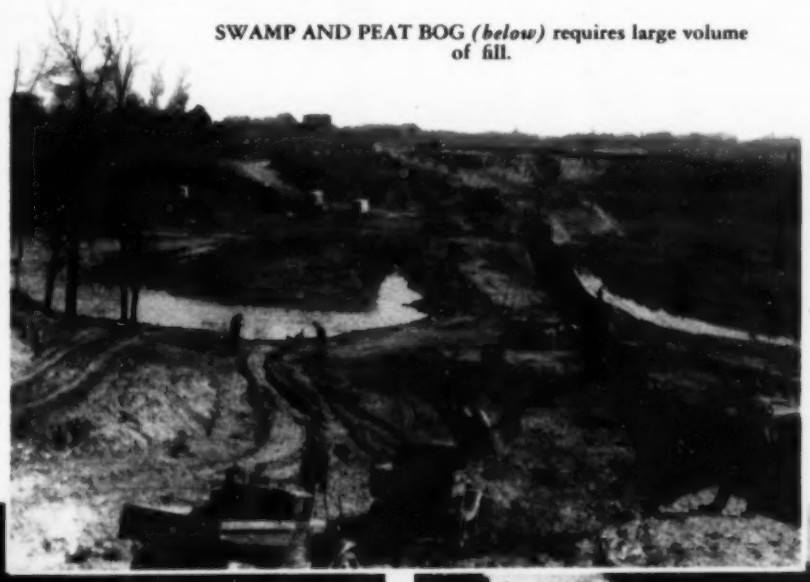
This project had a beneficial effect upon the relief situation in Minneapolis. Mr. Kjorlag, superintendent of the Division of Public Relief for Minneapolis, states that the city was feeding and providing shelter for 3,600 homeless men in the loop district at the time this job started. Early in the spring this was reduced to approximately 800 men per day. This project permitted most of these men to obtain board and room in the residential sections. In July this relief load for food and shelter was reduced to 500 per day.

After this project was shut down as a relief outlet in August, the shelter problem in the loop district immediately shot up to 2,200 men per day.

As a relief outlet for hand labor, the project indicated that the average worker was interested only in putting in the required hours on the job necessary to draw his check. It required considerable persuasion and "hard-boiled tact" to approximate the hours of work set up for the working day. Since the project began to show real progress, and power excavation created an atmosphere of activity, the better class of relief worker has shown much more interest in adding his bit to the accomplishment of a large job. He develops a loyalty and pride in being attached to, and being an integral part of, a real job which is showing definite and encouraging progress. The record of accomplishment on this project indicates that a small percentage of non-relief expense in power equipment can be efficiently combined with the work relief dollar to produce worthwhile public improvements at a reasonable cost.

To Carl F. Graeser, project engineer of the Minnesota Highway Department, most of the credit is given for the efficient administration of the many phases of activity on this project, as well as for coordinating the many bureaus and departments of construction and relief agencies having a definite connection with this relief project.

SWAMP AND PEAT BOG *(below)* requires large volume of fill.



CLAY AND GRAVEL TOPPING is spread over sand fill in roadway preparatory to paving operations.

MECHANICAL EQUIPMENT, used sparingly, helps step up production of hand labor.

RADIO

Controls Snow Plows and Cars

By LACEY V. MURROW

Director of Highways, State of Washington

RADIO-EQUIPPED rotary snow plow in Snoqualmie Pass.

MESSAGE *(above)* is transmitted by radio direct to operator in cab of snow plow. SNOW CONDITIONS *(below)* in Cascade Range pass.

HIGHWAY HEADQUARTERS at Olympia, Wash., is equipped with radio installation.

DURING THE WINTER of 1932 and 1933 the Department of Highways of the State of Washington began making field tests and gathering information on a radio communication system that could be applied efficiently and economically in the operation of mobile units, such as snow plows, and at fixed locations in the outlying and remote sections of the state. The first installations were made during the winter of 1933-34, being fixed stations at the summit of Snoqualmie Pass, at Crystal Creek Camp in Chinook Pass, and in the District Headquarters office at Seattle. Transmitting and receiving sets were also installed on two snow plows operating in Snoqualmie Pass.

After a few weeks of service this radio method of communication was found to be of such advantage that steps were taken to install a network covering the various other district headquarters' offices and all important mountain passes, as well as the several remote sections that either had no wire communication whatsoever or where, owing to physical conditions, wire lines were unreliable during stormy weather. The decision was also reached to equip all rotary snow plows with transmitting and receiving sets.

Installations of this latter character have proved to be of inestimable value and to illustrate their practical utility the following excerpts from road reports speak for themselves:

Jan. 21, 1935, 2:45 a.m.—Unofficial report received at Summit that 9 trucks, 2 pushplows and 2 passenger cars were caught by slides. One truck right in slide and balance of vehicles between slides. SnoGo A-241 called by radio and directed to get to the scene as soon as possible. Slide at Airplane Curve-West. (All confirmed.)

5:10 a.m.—SnoGo nearing slides. Calls Summit to find out which side of road trucks are on to avoid running into them with plow.

6:00 a.m.—SnoGo reports they have passed through one slide and are just coming on to another. Have not come across any vehicles as yet.

7:00 a.m.—SnoGo A-232 OK now and heading down west side. A-241 plowing near Denny Creek, headed up.

2:15 p.m.—Snoqualmie Pass. Slides still coming worse than ever. Road still closed. Do not know when it will open. Slides are at Airplane Curve. Average height of slides up to top of cutler bars. Have not yet reached trucks in slide.

Jan. 22, 1935, 2:20 p.m.—Three slides at Airplane Curve. Expect one-way traffic in five or six hours. Road open Summit to Easton. Narrow at Hyak.

8:10 p.m.—75 ft. of slide left.

9:35 p.m.—60 ft. of slide left.

Jan. 23, 1935, 12:01 a.m.—Passageway through slide at 11:45. Widening process to permit one-way traffic.

1:30 a.m.—One remaining truck in slide across one-way traffic lane. Cannot start traffic until wrecker removes.

5:30 a.m.—First traffic arrived at Summit 5:15. Will take about two hours for trucks to pass through. All trucks through in good shape.

Jan. 24, 1935, 9:00 a.m.—Snoqualmie Pass open for two-way traffic.

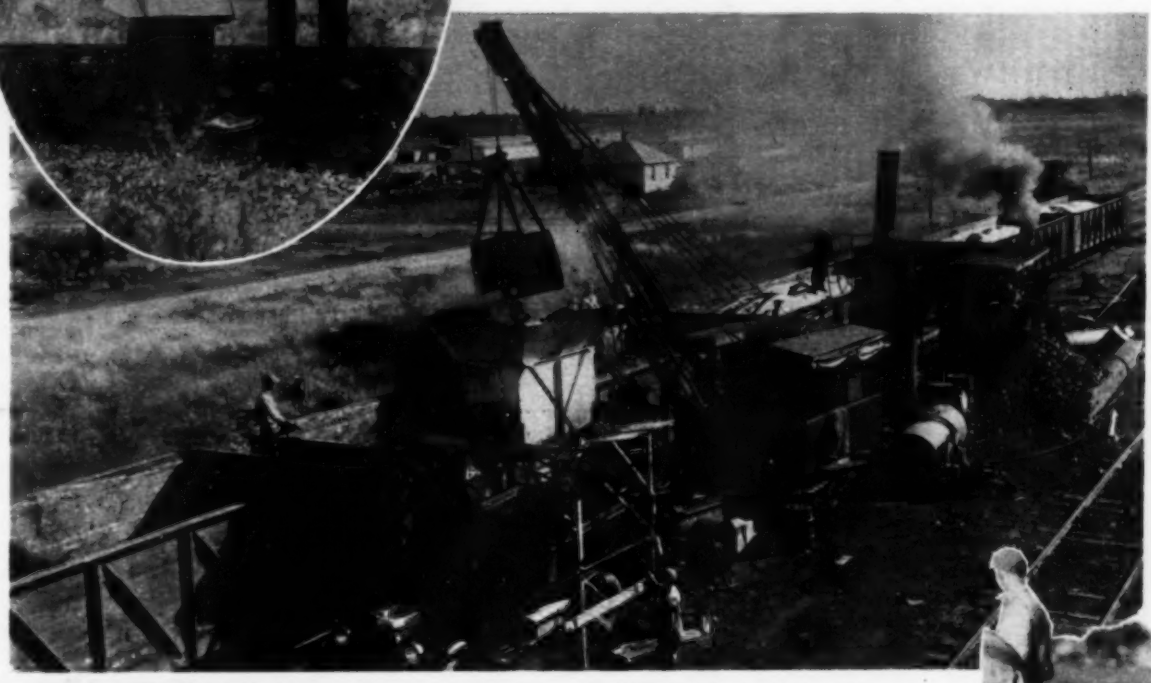
At the present time the setup consists of 17 fixed stations, 8 of which are of 50-watt capacity and nine of 10-watt capacity. The mobile stations operated are 12 in number, each equipped with transmitting and receiving sets of ten-watt capacity.

In addition, passenger business cars of district engineers, district maintenance engineers, district supervisors and the various department heads at Olympia have been equipped with short-wave radio receiving sets. These are set to the frequency at which the highway department is permitted to operate under Federal license, which limits uses to the business for which the installations are made. It has been found that so equipping these business cars is a decided convenience, enabling the operator of any or all cars to be apprised of conditions at any particular point or called to long distance telephone in case of any necessity for two-way communication with them.

The operation of this radio communication system is carried on at practically no expense involving special operators. The system employed is to make installations in shops and to encourage shop clerks and operators of special equipment, where mobile units are concerned, to become licensed radio operators which is necessary under Federal licenses. When properly licensed and otherwise duly qualified to operate radio equipment, shop clerks and other operators carry on in connection with the other duties that comprise their regular employment.

Wisconsin Builds BITUMINOUS CONCRETE *at Low Cost*

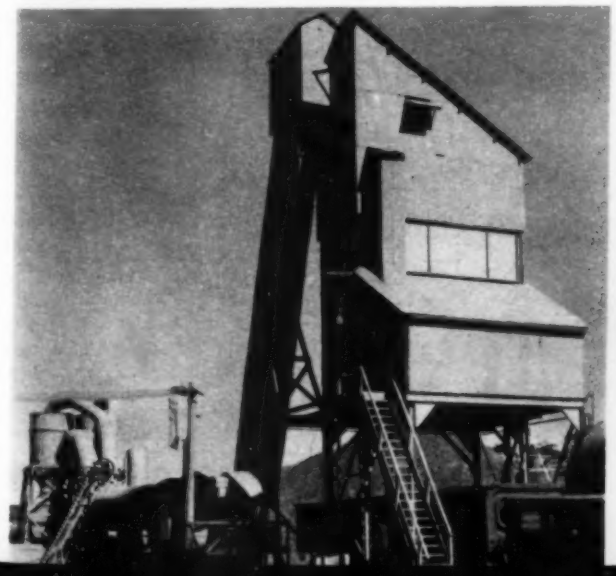
IN CHARGE of construction *(left)* on both contract sections: J. P. Humphries (left), contractor, and Wallace Diffor, resident engineer.



AT UNLOADING PLANT close to paving project, crane handling ½-yd. clamshell bucket transfers bituminous concrete from gondola cars into overhead hopper under which trucks are loaded. Two boilers supply steam to jets used to loosen material in cars.

AT A COST of $11,700 a mile, the Wisconsin Highway Commission last year laid 13.3 mi. of 2-in. two-course cold bituminous concrete 20 ft. wide on mixed-in-place tar-gravel base. The project duplicated in nearly all respects an adjoining 12.3-mi. contract completed in 1934 and still in splendid condition after a severe winter during which temperatures frequently dropped to 50 deg. below zero. J. P. Humphries, of Milwaukee, built the two projects, both of which are on State Trunk Highway 35, in the northwest corner of Wisconsin. The 1934 contract paved the road from Frederic to a junction 2 mi. north of Siren. Under his 1935 contract, Mr. Humphries extended the pavement farther north to Danbury.

Bituminous concrete for both projects was mixed at a permanent plant set up on a railroad siding at Dresser Junction, Wis. The rail haul to the unloading points averaged 50 mi. Materials were unloaded from gondola cars by crane and bucket and were hauled to the job in trucks which dumped into the hopper of an Adnun black-top paver. This machine laid the 1¼-in. binder course and ¾-in. top course in half widths. Traffic over the road was maintained at all times. Although the projects were built entirely by eye, without the use of a single grade stake, they provide a well-shaped pavement with excellent riding qualities. This result may be attributed in good part to the paving machine's ability to distribute and strike off the bituminous concrete to uniform grade.



MIXING PLANT *(left)*, 50 mi. from paving project, produces uniform bituminous concrete by accurate methods of weighing and mixer control. Dryer drum 42 ft. long and 6 ft. in diameter provides both for drying and for cooling crushed trap rock aggregate.

Base and Leveling Course—An existing oil-treated gravel surface provided a satisfactory foundation for the bituminous pavement. The highway had been graded and graveled about 7 years previously. During the interval it had worn and lost shape to some extent, but an average of about 2½ in. of oil-treated gravel remained. This surface was reshaped where necessary and was primed with an application of ¼ gal. per square yard of tar. The prime coat was blotted by spreading sand on the surface.

On the prepared base, the contractor built a leveling course of mixed-in-place crushed gravel and tar sufficient to make the total depth of existing gravel plus leveling course equal to at least 4½ in. Gravel pits were found adjacent to both projects, and a portable crushing and screening plant was set up at each site to produce graded aggregate for the leveling course. This course was built to a width of 22 ft., extending 1 ft. beyond the bituminous concrete top at each edge to give additional shoulder support. On the 1935 project, 13.3 mi. long, the leveling course required 17,000 cu.yd. of graded gravel.

STEAM JETS *(right)*, sunk into bituminous concrete in gondola cars, heat material and loosen it for unloading and transportation to job.

Motor graders dried the gravel by blading it back and forth across the road. After the aggregate was dry, a pressure distributor applied tar to the amount of 4 per cent by weight, usually in two applications, although three sometimes were required in building up superelevated curves. The tar and gravel were mixed by the blade machines after each application. Following the final blading, the leveling course was compacted by a pair of heavy steam rollers. As a result of careful work by the blading crew, the leveling course itself made an excellent riding surface for the large number of tourists using the road dur-

Approximate Average Proportions of Bituminous Concrete Mixtures

Material Per Cent by Weight

	Binder Course		Top Course	
	1934	1935	1934	1935
Mineral aggregate	93.8	94.0	92.8	93.0
Liquefier	0.7	0.5	0.7	0.5
Hydrated lime	0.75	0.5	0.75	0.5
Asphalt cement	4.75	5.0	5.75	6.0

Approximate Average Composition of Top Dressing

Material	*Per Cent by Weight*	
	1934	1935
Mineral aggregate (all passing ¼-in. screen)	97.0	96.0
Liquefier	0.7	0.9
Hydrated lime	0.3	0.6
Asphalt cement	2.0	2.5

Wisconsin Specification for Bituminous Concrete Mixtures

Material Per Cent by Weight

	Binder Course	Top Course
Coarse aggregate	84.0—92.0	75.0—90.0
Fine aggregate (passing ¼ in. screen)	4.0—8.0	5.0—15.0
Liquefier	0.2—1.0	0.2—1.0
Hydrated lime	0.5—1.0	0.5—1.0
Asphalt cement	4.0—6.0	5.0—7.0

Graded Coarse Aggregate 1935 Contract

Stone Size	*Per Cent by Weight*
Binder Mixture	
Retained on ⅜-in. screen	19
Retained on ½-in. screen	42
Retained on ⅝-in. screen	60
Retained on No. 4 screen	90
Top Mixture	
Retained on ½-in. screen	20
Retained on ⅜-in. screen	42
Retained on ¼-in. screen	80

ing the summer for automobile traffic.

Bituminous Concrete—Crushed trap rock of excellent quality from an adjacent commercial plant at Dresser Junction furnished the coarse and fine aggregate for the binder and top mixtures. The asphalt was Mexican base of 95-100 penetration. Aggregates were introduced into the mixer at a temperature between 90 and 100 deg. F., and asphalt was admitted, after the aggregate had been completely coated with liquefier, at a temperature of about 250 deg. F. Depending upon aggregate grading and atmospheric temperatures, the mixing cycle, from introduction of the dry materials to discharge of the batch, ranged from 3 to 4 min. The various operations involved in the complete mixing cycle were controlled by interlocking electric timing devices.

Accompanying tables indicate both the specified and actual proportions of the bituminous mixtures laid on the two projects. Grading specifications for fine and coarse aggregate allowed considerable latitude in sizes, and the proportion of asphalt had to be varied in accordance with the aggregate gradings. The mixes were designed to coat the particles of aggregate completely without introducing any excess bitumen into the pavement.

Mixing Plant—A revolving drum 42 ft. long and 6 ft. in diameter serves both to dry and to cool the aggregates at the mixing plant, eliminating the use of silos for the latter purpose. A single oil burner in the long drum is adjustable as to position; it can be moved forward or back inside the cylinder as required by the moisture content and volume of aggregates being dried. Little moisture is present in the rock and sand, received from the adjacent crushing plant. A special blower supplies air to the burner.

After the aggregates have traveled past the burner in the drum they are picked up by large-capacity flights on the walls of the drum and are cascaded at each revolution through a rushing draft of cold air, drawn through the drum at the rate of 32,000 cu.ft. per minute by a large suction fan. Repeated dropping through this air stream cools the aggregate to the specified temperature. Crushed trap rock is delivered to the dryer by truck from the nearby stone plant.

Dried aggregates are elevated to vibrating screens above three-compartment steel bins which feed by gravity into a weighing batcher. Both dry and wet ingredients of the mixture are weighed by beam scales equipped with needle indicators to assist the operator in cutting off the flow of material at the proper instant. A Cummer electric interlocking time control system regulates the intervals of the entire mixing cycle. The time locks for these intervals are adjusted in accordance with the aggregate grading, proportions of liquefier and asphalt, atmospheric temperature and other factors governing the period required for thorough mixing.

This system is set into motion by the opening of the hopper gate to discharge dry aggregates into the mixer, a Cummer 2-ton unit of pug-mill type. At the end of the first interval, which allows for introduction of aggregates into the mixer, the time-lock control releases the liquefier valve, permitting the operator to open it and add the liquefier to the mixture. The liquefier, a petroleum distillate which may be classified as a low-grade naphtha, is sprayed on the aggregate by a perforated pipe. After an interval of perhaps 15 sec., sufficient to assure thorough coating of the aggregate with the liquefier, the time control system releases a bar locking the asphalt bucket. This bar remains disengaged for about 45 sec., during which the asphalt bucket must be dumped and returned to horizontal position. At the expiration of the entire cycle, ranging in this case from 3 to 4 min., the timing apparatus unlocks the mixer gate, permitting the mixture to be discharged into a railroad car beneath the mixer.

By operating the plant 13 to 14 hr. a day, Payne & Dolan, the owners, were able to produce 450 to 480 tons per day for the 1935 project. Because of the relatively short rail haul, the railroad company permitted the gondola cars to be loaded with 60 tons each. The bituminous concrete in the cars was covered with strips of waterproof kraft paper.

Unloading Plant—On the 1935 project, the contractor set up his unloading plant at two sidings, the first at the north end of the contract and the second about 4 mi. from the south end. A 60-hp. vertical boiler and a 35-hp. threshing-machine boiler supplied steam for six jets used to loosen the material in the cars, for a water pump and for a small winch which spotted the cars. A crawler crane handling a ½-yd. clamshell bucket unloaded the bituminous concrete into an overhead hopper, equipped with a double-leaf bottom-dump gate, under which the trucks backed to be loaded.

Hired trucks carrying 4-ton loads hauled the material fom the plant to the spreader. Four trucks sufficed for the maximum haul of 6 mi. The truck bodies were equipped with canvas covers which protected the bituminous concrete on its trip to the spreader.

Construction Operations—In building the leveling course, the contractor

MOLDBOARD ATTACHMENT on blade of motor grader holds mixed-in-place tar-gravel base to uniform edge. **SIMPLE MOLDBOARD** *(right)*, made on job, is readily attached to grader blade.

SERIES of motor graders *(left)*, operating in staggered formation across width of road, mix tar-gravel base.

SELF-PROPELLED SPREADER *(below)* places, strikes off, and partially compacts bituminous concrete on one-half of pavement at a time. Traffic continues to use road throughout entire period of construction.

END-DUMP TRUCK backs between front guide wheels of spreader to discharge bituminous concrete into hopper of machine. Man at left holds timber templet for testing pavement profile.

operated five motor graders to dry the gravel and to mix it following application of the tar. These units ordinarily operated in batteries of three or four, arranged in serried formation across the road, with the intermediate and final graders picking up the windrows left by the preceding blades. The final grader was equipped with a home-made moldboard attachment which kept the material from spilling beyond the edge of the base and held the leveling course to a fairly uniform edge. After the final blading, the leveling course was compacted by a 12-ton three-wheel and a 10-ton tandem steam roller.

Construction of the 2-in. bituminous concrete top in two courses by the Adnun spreader successfully obliterated any objectionable inequalities in the riding surface of the mixed-in-place leveling course. By the bridging effect of its relatively long wheelbase, measuring 8.2 ft. between the front guide wheels and the forward rollers of the tandem pairs under the rear end of the machine, the spreader removed most of these inequalities in laying the binder course and completed the eradication of minor irregularities on its final trip, when it spread and struck off the surface course.

PAIR OF ROLLERS behind mechanical spreader compact binder and surface courses.

MECHANICAL SPREADER *(right)* is driven by gasoline engine furnishing power to two front guide wheels and two pairs of tandem rollers under rear end of machine. Long span between front wheels and rear rollers helps to bridge irregularities in base.

CENTRIFUGAL SPREADER *(left)* attached to rear end of dump truck distributes sand-asphalt filler on surface course.

The machine was propelled both by the front wheels and by the rear rollers. Material was dumped into the hopper from which it was fed continuously and uniformly on to the grade by a toothed roll feeder. Ahead of the rollers, the material was struck off by a reciprocating cutter bar, similar to the cutter bar of a mowing machine. The rollers partially compacted the concrete. Final compaction was effected by the two heavy steam rollers.

Production of the spreader on the 1935 project was dependent on the amount of material that could be supplied to the job by the mixing plant. During the summer the contractor employed two 6-hr. shifts 5 days a week. On an ordinary day, only eight cars of material were available. Working intermittently through a 12-hr. day, the spreader averaged 4,300 to 4,600 lin. ft of 1¼-in. binder 20 ft. wide. For ¾-in. top 20 ft. wide, the daily average was 5,200 to 5,500 lin. ft. When able to work more steadily throughout the 12 hr., the spreader laid as much as 5,700 lin. ft. of binder in one day and 6,000 lin. ft. of top in another day. Given an adequate supply of material, the contractor feels confident that he could complete 3 mi. of 2-in. pavement with the spreader in one week.

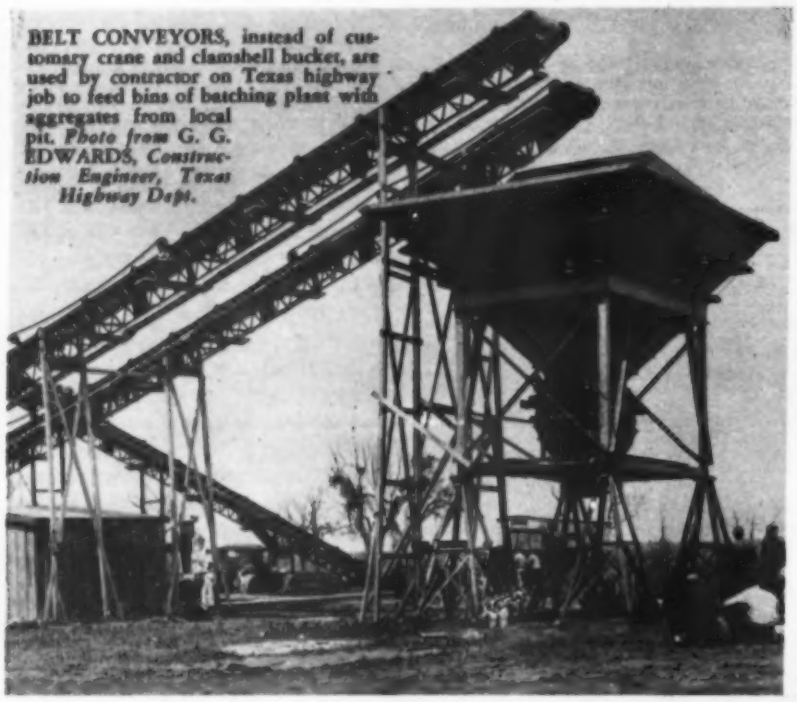
Top Dressing—To fill partially the voids in the top course and obtain a better bridging action between the stones, the surface of the pavement was given a light application averaging perhaps 6 lb. per square yard of sand-asphalt mixture containing 2 to 4 per cent bitumen. This filler application was distributed uniformly on the pavement by a mechanical rotary spreader at the rear end of a dump truck and was brushed into the voids by a broom drag before being rolled by a 6-ton tandem steam roller.

Personnel—E. L. Roettiger is state highway engineer of Wisconsin. Under the general supervision of G. I. Germond, division engineer, and S. W. Tuttle, assistant engineer of construction, Superior, Wis., the work on the two bituminous concrete projects was directed by Wallace D. Diffor, resident engineer. J. P. Humphries, the contractor, was personally in charge of construction.

Getting Down to

DETAILS

[Close-up Shots of Job Methods and Equipment]

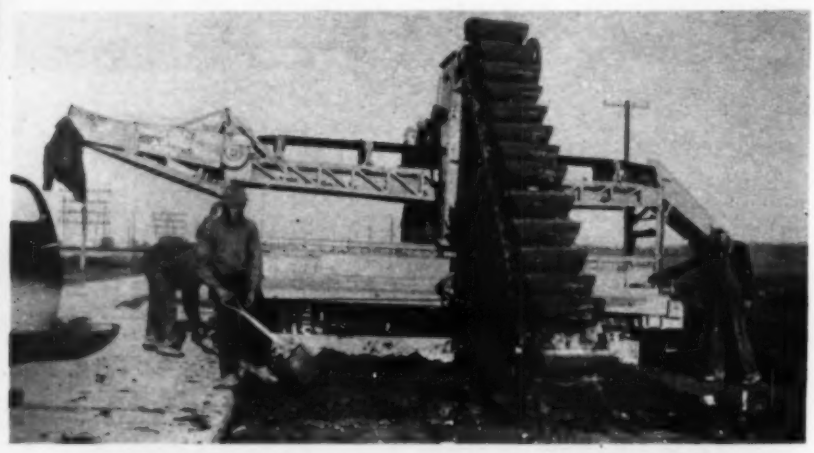


BELT CONVEYORS, instead of customary crane and clamshell bucket, are used by contractor on Texas highway job to feed bins of batching plant with aggregates from local pit. *Photo from* G. G. EDWARDS, *Construction Engineer, Texas Highway Dept.*

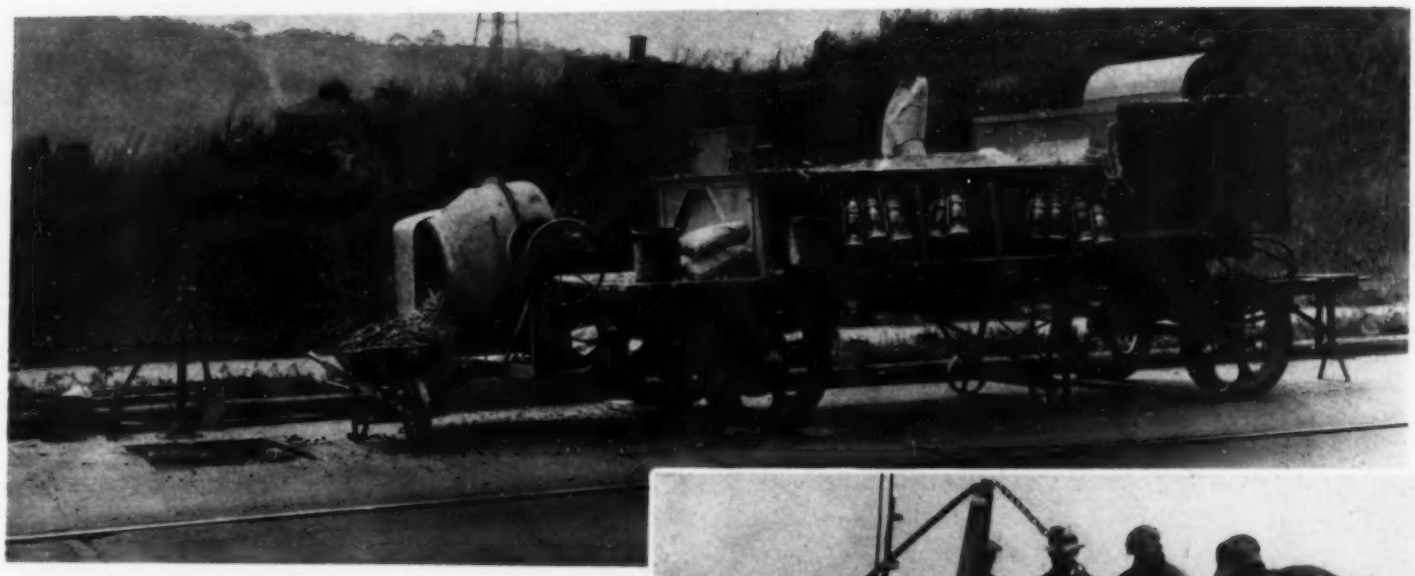
FOR LOAD TRANSMISSION across expansion and contraction joints Illinois Division of Highways installs new type of J-Bar supports in concrete pavement at Caledonia, Ill. E. M. Melahn, contractor, of Algonquin, Ill., orders bars assembled complete with Ace joints at factory ready for installation. J-Bar consists of ¾x4-in. cold-rolled steel shaft fitted at both ends into heavy malleable iron sleeves carrying face lugs and wing anchors designed to distribute all imposed loads into concrete slab. Rigid unit assembly of joint assures accurate positioning of dowels and eliminates need of hiring and training men to assemble joint at roadside.

MOWING MACHINE for highway shoulder maintenance in Kansas is mounted on McCormick-Deering tractor by special rig.—*Photo from* H. D. BARNES, *State highway engineer of Kansas.*

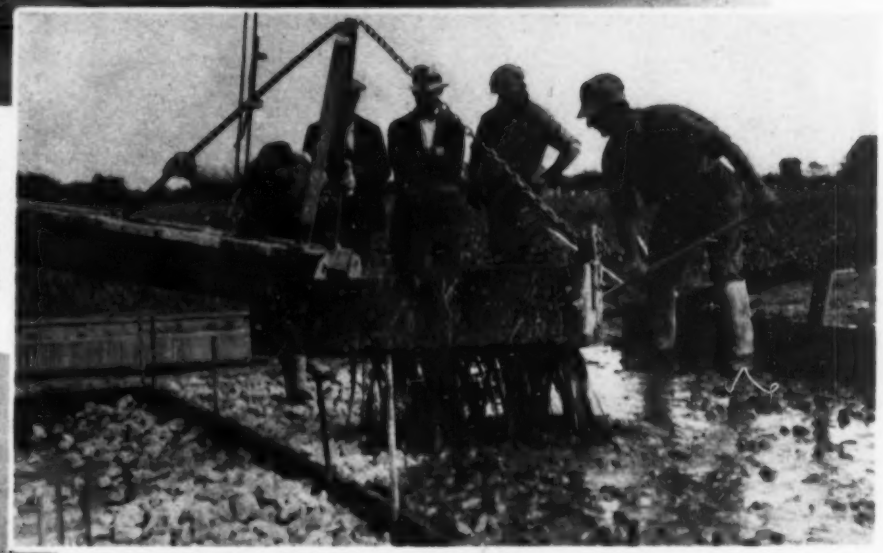
TRAVELING BITUMINOUS PAVER produces mixture for mat surfacing 1½ in. thick on 20-ft. wide highway on Route 5 in Laclede County, Missouri. Barber-Greene plant, consisting of bucket loader and mixer on crawler mounting, gathers aggregate from windrow along subgrade with aid of spiral pickup and, after applying asphalt in pug mill mixer, deposits material in continuous pile at rear for spreading and finishing. *Photo from* R. M. WHITTON, *Division Engineer, Missouri Highway Dept.*

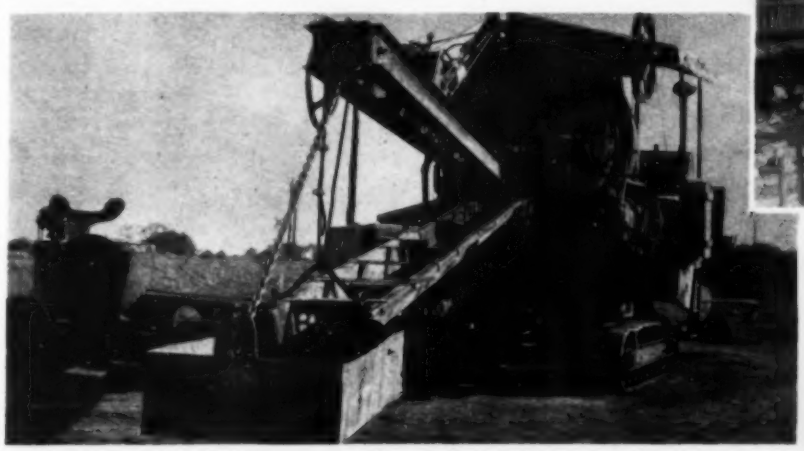


UTILITY GRADER, developed by A. W. French, of Chicago, to handle cuts up to 7 in. deep and 13 ft. wide, operates on own crawler tracks, thereby eliminating need of first setting road forms before cutting finished subgrade. Grade of cut, made with buckets, is controlled by leveling frame adjusted to line set from engineer's grade stakes. Buckets deliver to transverse belt conveyor for loading trucks or spilling along shoulder. Machine applicable also to shoulder work.

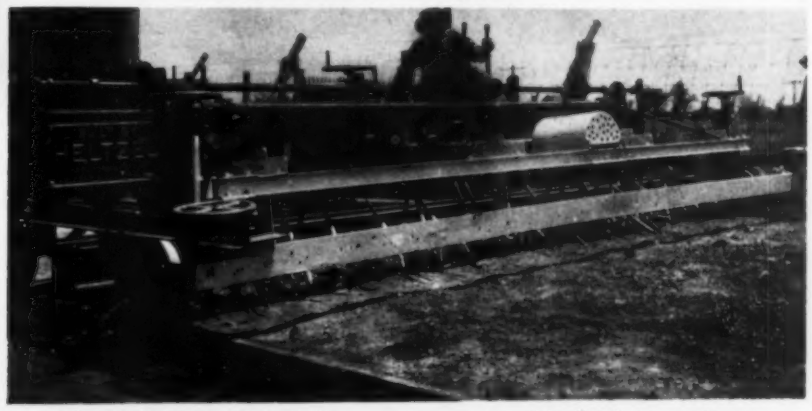


PAVEMENT REPAIR TRAILER, operated by two men, proves useful for restoring service cuts in concrete pavements of Cincinnati, Ohio. Concrete mixer on rear end is fed with coarse and fine aggregate stored in separate compartments on trailer body. Water tank mounted at front end. Cement and tools carried in waterproof compartment under tank. Tail gate drops to form horizontal platform for mixer operator. Concrete delivered by wheelbarrow to pavement cut.—*Photo from* C. E. BROKAW, *superintendent, Division of Highway Maintenance, City of Cincinnati, Ohio.*





GROUT DISTRIBUTOR *(above and at left)* **in form of chute and perforated box acting as strainer head, replaces bucket on standard 27-E paving mixer in building cement-macadam road near Camp Perry, Ohio. Equipment illustrated insures uniform distribution of grout upon surface of crushed stone placed in layer 7 in. thick and rolled with 5-ton roller to aid penetration of cement grout.**



INTERNAL VIBRATION of concrete pavement on job of Erie Excavating & Contracting Co. at North Benton, Ohio, is accomplished by new Heltzel finishing-machine attachment consisting of rigid transverse frame supported independently on springs and rubber-tired wheels. Entire frame is vibrated by master vibrator. Transverse shaft attached to frame supports 150 rotating vibrating elements which penetrate concrete and move in and out to depth of 5 in.

LONG BOOM, with reach of 30 ft. on MultiFoote paver operated on Oklahoma concrete pavement by Ellis & Lewis, Inc., contractors, of Muskegee, enables wire mesh reinforcement to be bought and placed in 20-ft., instead of the usual 13-ft. sections, thus saving one lap to each 40-ft. joint. Pavement is concreted in single 20-ft. lane instead of two 10-ft. lanes. Long boom is of value also in city paving where wide intersections demand longer reach of power boom than do state highways. Paver can be kept entirely outside forms in many cases.

DIAGONAL FLOAT 20-ft. long, devised by G. H. Lamb and towed by automobile, gives exceptionally smooth finish to 10-ft. strip of California pavement.—*Photo from* H. A. WATERMAN, *assistant construction engineer, California Division of Highways.*

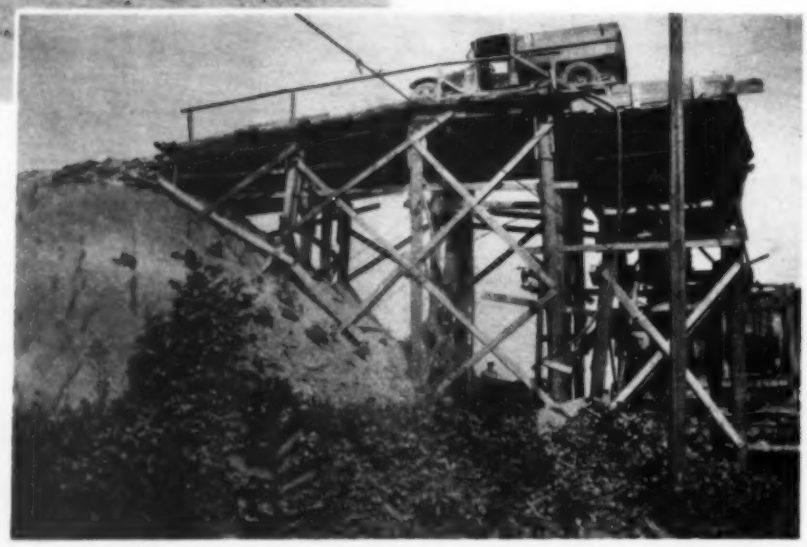
Indiana Builds

By Applying Brine to

MIXING PLANT designed for gravity operation provides for truck delivery of crushed limestone, sand and clay to overhead bins. Materials pass in turn to weighing batchers, mixer, and hopper erected on timber posts above truck loading station. In right background is commercial crushing plant which produces limestone aggregate.

A PLANT MIXTURE of graded limestone, sand and clay, spread in layers and moistened with a solution of common rock salt, provided the substance of a dense and dustless 6-in. by 20-ft. road 20½ mi. in length completed last fall for the Indiana State Highway Commission on State Route 46, between Spencer and Ashboro, by Clark, DuVall & Sparling, contractors, of Flora, Ind. Designed as a stabilized soil-stone mixture, with sufficient salt added to preserve the bonding quality of the clay, the material in the road seasoned steadily under traffic and at the end of a few weeks presented a hard, smooth surface free from loose stone. Prior to construction of the stabilized surface, state highway engineers made a thorough investigation of underground water sources and located drains and culverts to carry away all subsurface moisture.

Purpose of Project—Construction of a stabilized salt-soil road on this part of Route 46 was undertaken as a means of shortening the period required to obtain a compact, stable base for a future bituminous wearing course. By ordinary traffic-bound methods of base construction, three years are needed to work the road metal and binder into a dense, permanent combination. It is the intention of the Indiana highway engineers to pave the Spencer-Ashboro project with a one- or two-course bituminous wearing surface in less than one year. To prevent any misunderstanding of the function of a salt-soil road, it must be stated that the later addition of a bituminous top is in no sense essential to the continued useful service of the stabilized course. On the contrary, most stabilized salt-soil roads are built to serve as self-sufficient highways without addition of any supplementary surfacing, although the stabilized base does provide a first-class foundation for later paving, if it is desired.



TRUCK backs up timber ramp to deliver load of aggregate into overhead bins of mixing plant.

Theory of Stabilization—In the construction of salt-soil stabilized roads, a mixture of graded coarse aggregate, fine aggregate and clay binder is designed in the proper proportions to form a dense mass of natural concrete with a minimum of voids when compacted. In the case of the salt-soil road, ordinary sodium chloride is added to the material during construction, as an admix-

SELF-PROPELLED BUCKET LOADER (*below*) picks up pulverized clay and places it in truck for delivery to mixing plant. Sloping screen on truck body rejects oversize lumps.

TRACTOR-DRAWN BLADE GRADER and ¾-yd. dragline improve side slopes, berms and ditches at intersection of salt-soil stabilized project with rural road

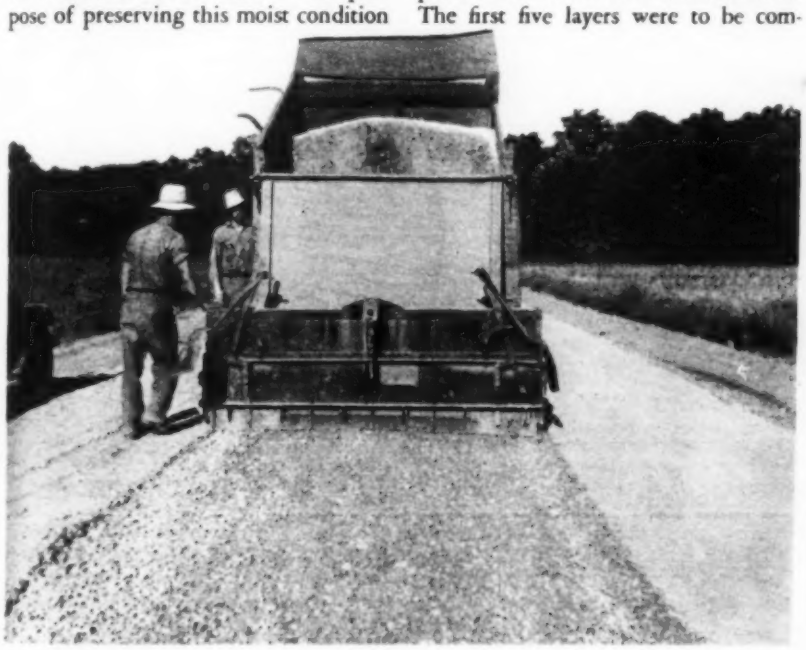
Stabilized Salt-Soil Road

Clay-Sand-Stone Mixture

AMONG THOSE IN CHARGE of construction *(right)* are: (left to right) Ross DuVall and Scott Clark, of contracting firm, and Lafe Stewart, project engineer.

ture; to maintain the toughness of the road. The commercial grades of rock salt are commonly used in this type of construction.

Any properly designed stabilized road remains sound and stable under traffic while it contains the proper amount of moisture, regardless of whether deliquescent material has been added to the stabilized mixture. The binding agent in the mixture is the clay, the particles of which have a high cohesive quality so long as they are covered by a thin moisture film. In the salt-soil road the salt is added for the purpose of preserving this moist condition by its deliquescent and moisture-retaining properties. Salt furthermore increases the surface tension of the moisture film and enhances the cohesive properties of the binder.



SPREADER BOX attached to rear of dump truck distributes mixed materials for multi-course construction of salt-soil stabilized road.

Design of Stabilized Road—Specifications for the 20½ mi. of stabilized construction between Spencer and Ashboro called for a compacted surface 20 ft. wide having a uniform thickness of 6-in. and a roof (or A-shaped) crown dropping from the center line to the edge at the uniform rate of ½-in. per foot. A steep crown of uniform gradient is required on stabilized soil roads to obviate danger of pools collecting on the surface in wet weather and causing subsequent water pits and rutting. If a salt-soil road is properly drained, it sheds water readily, as the surface becomes practically impervious when it has absorbed a small amount of rainfall. However, if water is allowed to collect and stand on the surface, the road material becomes softened by saturation, and traffic produces small water-pits which later cause greater progressive damage to the road through loosening and eventual loss of binder and road metal.

Original specifications required that the stabilized 6-in. mat be built up in six 1-in. layers, each layer to be treated with the proper proportion of salt applied in the form of a brine solution. The first five layers were to be compacted under the pneumatic tires of a dual-tired truck, and the final layer was to be compressed by a 10-ton roller. This construction specification was followed closely during the early stages of the project but was modified later as the engineers and contractors gained experience in utilizing the plant-mixed material.

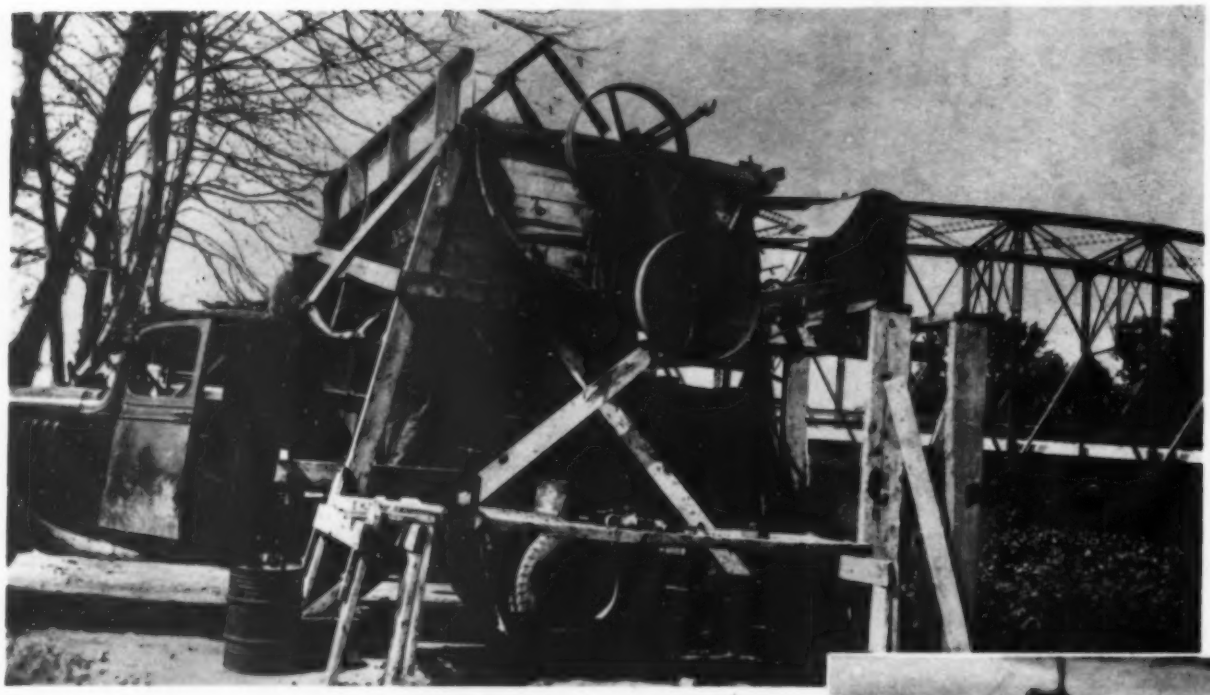
THREE SPREADER BOXES covering entire width of road distribute clay-sand-stone mixture for each layer of stabilized construction.

Mechanical Analysis—Specified tolerances in the proportions of various sized aggregates and soil fines for Indiana stabilized mixtures are given in the accompanying chart, which also reproduces the average proportions of the mixtures for the 3-in. lower course and 3-in. upper course of the 6-in. compacted thickness on the Spencer-Ashboro project. Indiana uses the maximum possible proportion of stone for the purpose of obtaining added density, durability and abrasion-resistance in the road. A small proportion of stone retained on the 1-in. screen also is permitted in the Indiana mixture, although this size is not commonly permitted elsewhere. It will be noted from the typical mixtures indicated on the graph that the base course contains a greater proportion of the large stone sizes than the surface course.

Plasticity Index—An important element in designing a stabilized mixture is the use of a clay with the proper binding quality. Without going into the subject at too great length, it can be stated that a mechanical method of measuring the binding property of clays has been developed. This measure is known as the plasticity index.

A practical example may serve to set up a rough definition of the term plasticity index. Taking a dry sample of a clay to be tested, it will be found that a certain amount of moisture, in per cent by weight of the dry soil, has to be added to the sample to render the material plastic, as determined by a standardized mechanical test. Further addition of moisture eventually changes the sample to a semi-liquid condition, as determined by another standardized mechanical test. The moisture content as before is expressed in per cent by weight of the dry sample. To measure the binding quality, or index of plasticity, of the sample, the first moisture content is subtracted from the second. The difference equals the plasticity index.

For example, it may be necessary to add 10 per cent by weight of water to



IMPROVISED MIXING plant for making brine solution of rock salt and water consists of elevated semicircular wooden tank divided into two compartments. Water is pumped from stream, and weighed rock salt is delivered to tank by wheelbarrows traveling up ramp from stockpiles on ground to runway alongside tank.

a dry soil sample to make the material plastic. To change the plastic condition to one of semi-liquidity, as mechanically determined, an additional charge of 25 per cent of water may be needed, making the total moisture content 35 per cent by weight of the dry soil. The index of plasticity then will be 35 minus 10, or 25.

Indiana specifications call for a plasticity index between 6 and 11 for all materials passing a No. 40 sieve. For the project under consideration, a plasticity index of about 10 was desired. It will be noted from the graph that about half of the material passing the No. 40 sieve consists of fine sand with no cohesive property. The clay locally available had a plasticity index of 23. To cut this index down to 10, it was necessary to add the fine sand to the mix. Indiana limestone crushes with a minimum of dust; only about 5 per cent usually passes a No. 40 sieve. Therefore stone dust or sand must be added to all stabilized mixes using limestone.

Grading and Drainage — Thorough subgrade drainage is of fundamental importance in the construction of a durable stabilized road. As is customary on Indiana construction projects, the engineers investigated all underground springs and water-bearing strata and traced the water to its source with soil augers. At each location where water was discovered, drains were installed to intercept it before it reached the roadway. The excavation at the head of each drain was back-filled with rock to catch the water. Both tile and perforated, corrugated metal pipes were used in these installations. In addition, the contract called for adequate side ditches, cross drains and culverts.

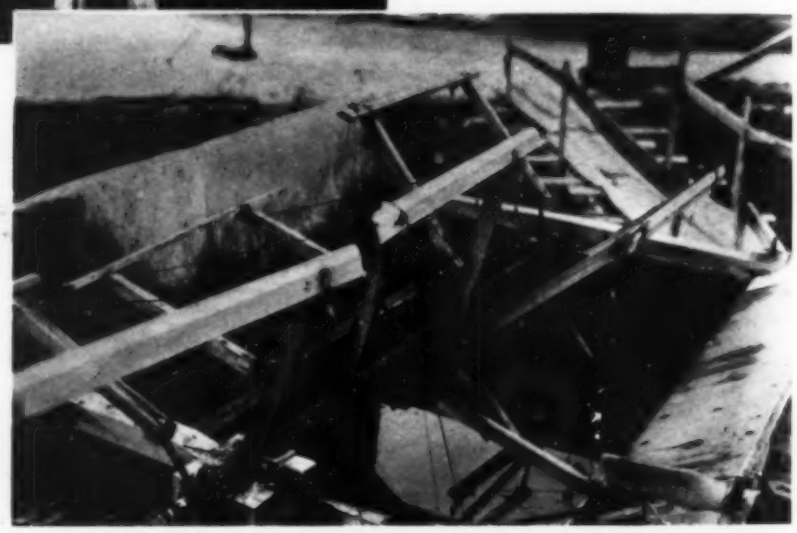
DISTRIBUTOR TANKS mounted on trucks apply brine solution to each layer of salt-soil stabilized road. Solution is applied by gravity through two spray bars at rear of tank. Truck driver regulates speed to apply brine at specified rate.

Trenching and trimming of the rough grade to subgrade profile required the removal of about 1,000 cu. yd. per mile. Most of the road was constructed close to existing line and grade, but about 5 mi. toward the east end of the project was built on new grade requiring the movement of about 40,000 cu. yd. of material. The subgrade in general consisted of clay.

Mixing Plant—A commercial limestone quarry and crushing plant about one mile from the east end of the project supplied the graded coarse aggregate for the stabilized soil-stone mixture. Against a hillside close to the crushing plant, the contractors set up a mixing plant equipped with a 27-E paving mixer to produce mixed batches of stone, sand and clay for the road. This plant was arranged for gravity flow of materials from a truck ramp at the top to overhead bins, to weighing hoppers, to the mixer, and finally to trucks which backed under the mixer. Overall height of the plant, from the truck roadway under the mixer to the truck ramp delivering to the overhead bins, was about 42 ft.

For the first 10 mi. of road, the plant produced batches weighing from 2,350 lb. to 2,700 lb. each, the proportions of stone, clay and sand being varied occasionally to improve the quality of the mixture. For the final 10 mi. construction, when production was at its maximum, the mixture was standardized at 2,500 lb. of stone, about 410 lb. of clay, and about 510 lb. of sand. The mixture was produced at the rate of about one batch every 45 sec.

To uncover clay of the desired plasticity, the contractors stripped from 2 to 3 ft. of silt and clay overburden from a sloping field behind the stone quarry. Only limited areas of the clay bank were worked at any one time, care being taken to see that slopes and channels for free drainage were maintained to prevent collection of pools of water on the clay. A tractor-drawn blade grader stripped the overburden and cut and spread the clay bank for drying and pulverizing. A disk harrow broke up the clay lumps and pulverized the material with the aid of a roller. The clay then was loaded into a truck by a traveling bucket elevator, as illustrated by a photograph. A sloping screen above the truck body rejected oversize lumps. Specifications required that all the clay-soil pass a 1-in. sieve and that 80 per cent pass a No. 4 sieve.



PADDLE WHEELS salvaged from old threshing machines agitate water and salt solution in brine mixing tank. Gasoline engine turns shaft on which paddle wheels are mounted. Simple clutch engages and disengages paddle wheels.

Sand was excavated at a bank about 2 mi. from the mixing plant and was hauled to the plant by trucks. As already indicated, the trucks hauling stone, clay and sand backed up a ramp to dump their loads into the overhead bins.

Brine Solution—As salt is deliquescent only at periods of high humidity, the Indiana highway engineers desired to hasten the process of leaching it into the clay and obtaining a more intimate combination of the two materials by applying the salt in solution, and the

contract specified this procedure. Two gravity sprinklers consisting of 450-gal. rectangular steel tanks were mounted on trucks and equipped at the rear with perforated distributor pipes for applying the brine to half widths of road. For the major part of the project, brine was mixed in a 60-per cent solution consisting of 720 lb. of rock salt in 450 gal. of water. Toward the end of the work, as construction speeded up, the percentage of salt was varied in accordance with the humidity. In all cases, the truck drivers correlated their truck speeds with the strength of the solution to apply the specified quantity of salt and water. Construction of the 6-in. road 20-ft. wide required 27 tons of salt per mile.

To mix the brine solution, the contractors improvised a plant consisting of two semi-circular wooden tanks in which the water and rock salt were agitated by paddle wheels retrieved from old threshing machines. During the construction of the project, the plant was set up at two locations, one about 5 mi. from the west end and the other about 2 mi. from the east end. The tanks were elevated on timber frames to permit the sprinkler trucks to back into them to be loaded. At each location of the plant, a small gasoline-powered pump delivered water from a nearby stream to the tank. A second small gasoline power plant turned the paddles.

hauled material from the mixing plant at one time.

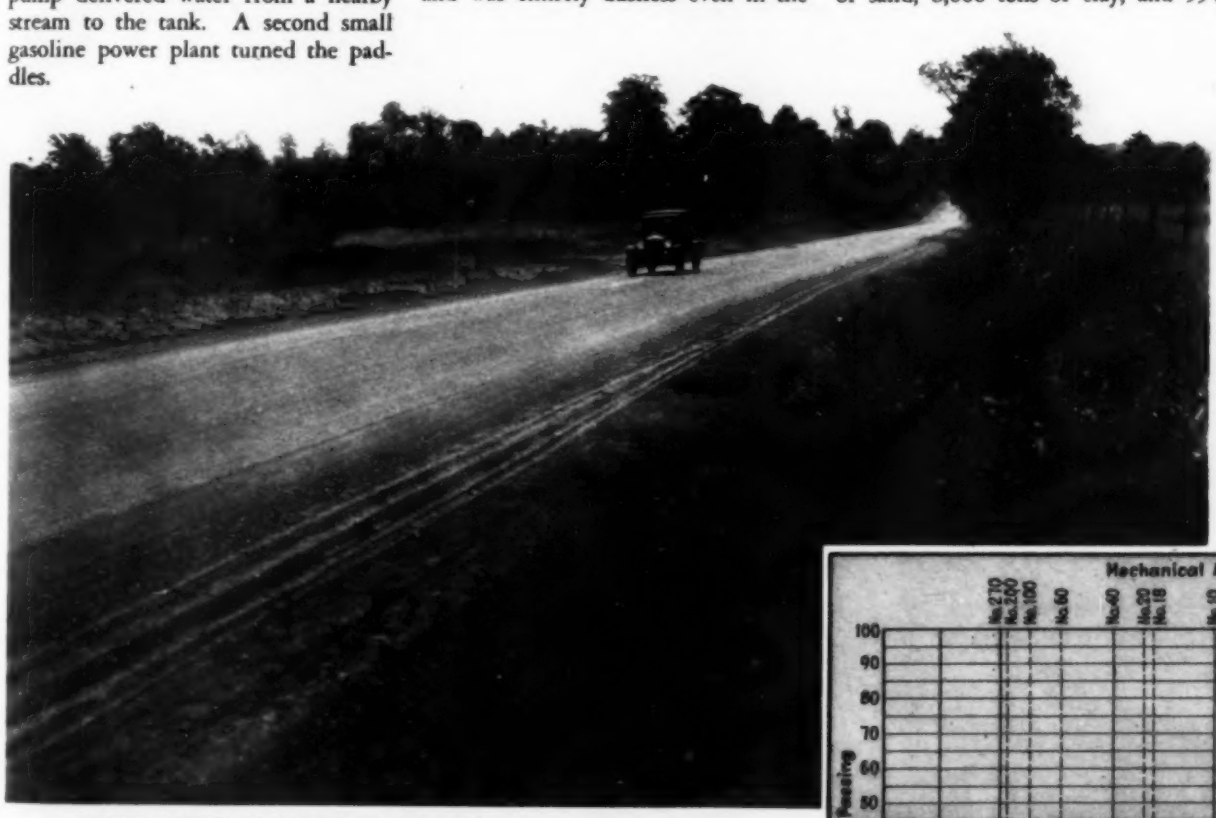
Construction started at the west end of the project and proceeded to the east. During the summer, progress was retarded by frequent rains, but in the last five weeks of construction, the contractors built the final 10 miles of road, placing about 36,000 tons of mixed material in this period by working 20 hr. a day.

As already stated, the road at the start was built up in six 1-in. layers. This procedure was varied as indicated by experience until it eventually resolved into the construction first of a 2-in. compacted base followed by building up a 4-in. top in three applications. All layers except the last were compacted by a dual-tired 7-ton truck and the batch trucks.

Following the compaction, each layer was treated with a brine solution at the rate of about 4 tons of salt per inch of thickness per mile. The top layer was compacted with a 10-ton roller. For best results, it was found desirable to allow the base course to cure for a week or longer before placing the layers of the top course.

A seasoning period of several weeks followed the final application of brine to the surface of the road. At the end of a month, the road had set up hard and was entirely dustless even in the

MULTIPLE-BLADE DRAG smooths surface of completed road during seasoning period. This shaping, which can be carried out only when surface has been wet by rain, is continued for several weeks following construction.

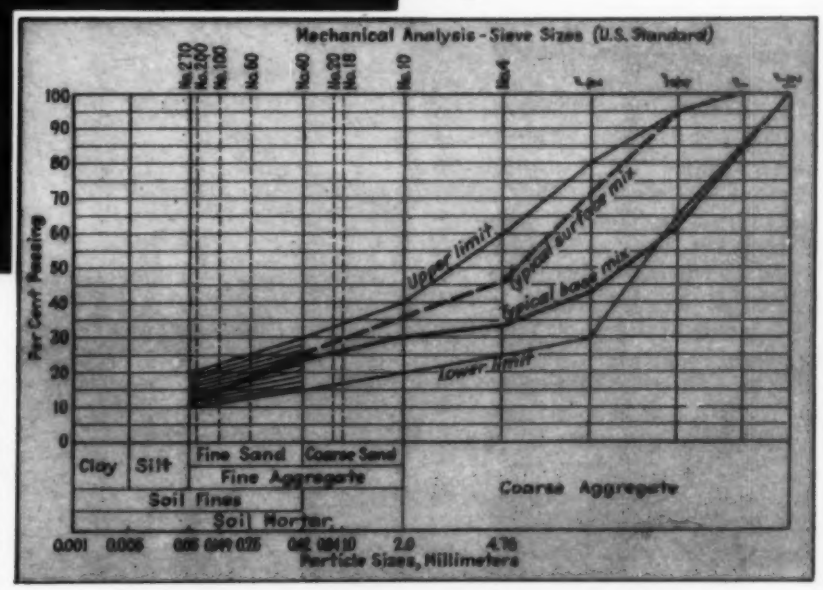


DENSE, DUSTLESS WEARING SURFACE with good riding qualities is final product of stabilized salt-soil construction at end of short seasoning and smoothing period.

Construction Procedure — Specifications required that the subgrade be primed with brine before the first layer of stabilized material was placed, but it was found advisable to omit this priming when the subgrade was damp. Mixed material was delivered by trucks to spreader boxes about 10 ft. wide which laid the material to the desired depth on one-half the road at a time. As many as 42 trucks of various sizes driest weather. During the curing period, small pits and potholes in the surface were patched with a stabilized mixture containing ⅜-in. stone as the maximum size aggregate. A 90-per cent salt solution was used to prime the spot to be patched and to treat the patch itself after the hole had been filled. After rains during the curing period, the surface was soft enough to be worked. At these times the contractors smoothed the surface with a multiple-blade maintainer.

Quantities and Cost — Construction of a 6-in. by 20-ft. stabilized road on this 20½-mi. project required 70,000 tons of crushed limestone, 10,000 tons of sand, 8,000 tons of clay, and 594 tons of rock salt purchased from the Morton Salt Co. Total cost of the project, including grading and all concrete structures, amounted to $180,000. As for the actual construction cost of the stabilized surface, it is estimated that materials and labor on the last 10 mi., when production was at its peak, averaged about $5,300 per mile.

Administration — M. R. Keefe is chief engineer of the Indiana State Highway Commission, and Sultan G. Cohen is engineer of construction. Development and control of stabilized road materials in the state are largely in the hands of A. R. Brickler, assistant engineer of tests, acting under Arthur Smith, engineer of tests. Field work on the project described was directed by H. O. Martin and Lafe Stewart, project engineers, each of whom was responsible for about one-half of the total mileage. Construction operations were personally supervised by the contractors, Scott Clark, Ross DuVall and George Sparling.



STABILIZATION CHART indicates specified upper and lower limits in percentages by weight of various aggregate sizes involved in design of stabilized mixtures. Two heavy lines mark proportions of typical mixtures for 3-in. lower course and 3-in. upper course on this project.

Wisconsin's Concrete Standards for

Winter Bridge Construction

FOR THE LAST ten years the State Highway Commission of Wisconsin has carried on winter construction of concrete bridge structures as a regular part of its annual program. This practice has grown to a point where practically as much concrete now is placed in bridges during the winter as during the summer. As a result of its long experience with winter construction, the highway department has been able to write a set of specifications for this type of work which assure the production of concrete structures of high quality. In fact, although the cost of winter concrete under present conditions is estimated to be about 10 per cent higher than the cost of summer concrete, the bridge engineers of the highway department feel that the closer control of curing required in cold weather assures a finished product of comparable quality, permitting an increase in the length of the construction season without any sacrifice of warm-weather standards.

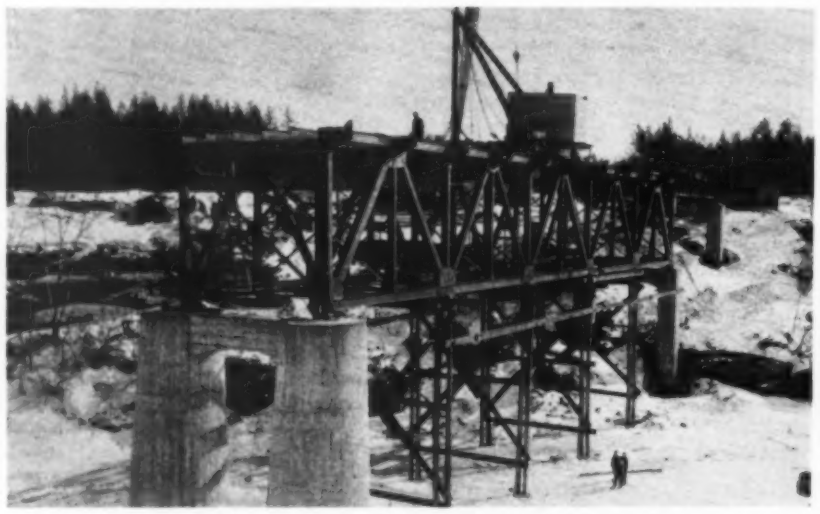
During the long period of Wisconsin's experience with winter construction of concrete bridges, the contractors engaged in the work in that state have become highly skilled in the art of cold-weather concreting. A recent example of this skill on a winter project was afforded by a bridge on state trunk highway No. 27 across the Eau Claire River, started in October, 1934, and completed early last summer by the Hoeppner-Bartlett Co., of Eau Claire, Wis., contractor. The new bridge replaced an inadequate existing structure at the site. A plan and elevation accompanying these notes indicate the design and principal dimensions of the new bridge, which required a total of 850 cu.yd. of concrete for its piers, abutments and deck. Steel deck trusses carry the roadway on the two main spans, while deck plate girders are used on the four approach spans.

Special provisions of the highway department's general specifications required the contractor to begin operations not later than 10 days after the date of official notification and to prosecute the work throughout the winter months. The provisions specifically state that cold weather is not to be considered a cause for suspension or delay of any work excepting painting. In the case of the Eau Claire River bridge, the final execution of the contract was made on Oct. 24 and work started at the site on Oct. 25, 1934. The contract price was $56,800.

Mixing Concrete—According to the specifications for concrete which is mixed while the temperature of the air is lower than 35 deg.F., the aggregates or mixing water or both must be heated to produce a temperature of the concrete at the time it is placed in the forms of about 70 deg.F. In no case must the aggregate be heated to a temperature exceeding 180 deg.F., and the temperature of the concrete mixture when placed in the forms must not fall below 60 deg. nor exceed 100 deg.F. Heating of cement is not allowed under any conditions, nor is the use of aggregate containing frost, frozen or hardened lumps permitted. Use of salt, chemicals or other foreign materials to lower the freezing point of the concrete likewise is prohibited.

At the Eau Claire River bridge, the Hoeppner-Bartlett Co. heated the aggregates by steam jets in stockpiles covered with canvas. During periods of nominal temperatures water was heated by running the supply through a boiler; but during severe weather, when temperatures were low, a steam jet was used to heat the water in a reserve supply tank. These heating methods for aggregates and water proved effective, as the concrete, when deposited in the forms, never had a temperature less than 70 deg. or greater than 96 deg.F.

Concrete was mixed by a 14-S mixer. Only two of the pours were large, and



FOLLOWING WINTER CONCRETING of south abutment and piers 1, 2 and 3, contractor proceeds with erection of steel truss and plate-girder spans on these structures.

CANVAS HOUSINGS protecting abutment and two piers at south end of bridge are made up of two layers of canvas on 4x4-in. timber frames with 4-in. air space between layers.

MIXER AND BOILER are set up adjacent to pier 4 and north abutment, forms for which are being erected. Boiler heats aggregates and mixing water for concrete and later supplies steam to canvas inclosures.

MAIN PIER at center of river is housed in double-walled canvas inclosure intersected by old deck-truss bridge. Steam coils and live steam maintain required interior temperature and supply moisture for curing.

the 14-S mixer produced the concrete for each of these in 12 hr. Hand carts were used to distribute the concrete from the mixer to the forms. In general, the carts were able to deposit the concrete directly into the forms, although in one or two places it was necessary to use metal chutes for further distribution.

Protection — Wisconsin's specifications require that concrete placed at a temperature below 36 deg.F. be protected by adequate housing or covering and heating. The surrounding air must be maintained at a temperature of 50 deg.F. or greater during the period required for curing and in no case for less than 72 hr. after placing. Methods of protection and heating must be such as to prevent evaporation of moisture from the concrete. Salamanders are not permitted within the inclosure. Sufficient illumination is required to permit men within the inclosure to work unhampered by any lack of light.

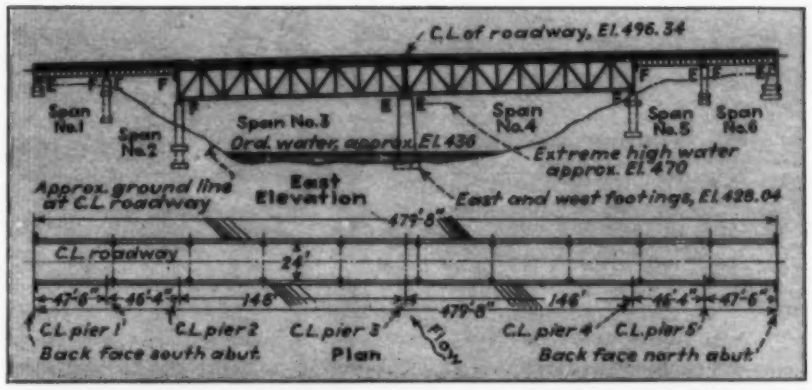
On the contract under discussion combination wood and canvas housings were employed to protect most of the units. A timber frame of 4x4-in. pieces was covered with two layers of canvas, one inside and one outside the frame, providing a 4-in. dead-air space between the two layers. Some of the units were entirely inclosed with wood sheathing. It was found that a double thickness of canvas, with dead air trapped between the two layers, afforded more effective protection than a single layer of wood sheathing.

Steam coils and live steam were used to heat the interiors of the inclosures. During the curing period, the joints in the heating coils were "cracked" to allow live steam to escape and provide sufficient humidity for proper curing. When men were at work in an inclosure the joints were tightened, and the concrete units were sprayed with water, but at all other times during the curing period moisture was furnished by the escaping steam. The initial curing period ranged from 3 to 7 days, depending upon the outside temperatures. After the live steam had been turned off at the end of the curing period heat was provided in the unit for a period of from 8 to 21 days, depending upon the outside temperatures.

An important step in the proper curing and protection of the concrete was the gradual cooling of the unit to the outside temperature. At the end of the regular curing period the heat in the inclosure was gradually stepped down until the housing was no longer heated, but the housing was required to remain in place until the concrete was near atmospheric temperature and the engineers deemed it sufficiently cool to permit it to be exposed to the elements. During the heating of the units the temperature inside the inclosures was held to at least 50 deg.F. Units were housed for various periods ranging from 17 to 23 days.

An accompanying table indicates the concrete placing and curing schedules for nine units. A wide range may be noted in the number of days during which various units were heated and housed. These variations may be attributed to the range of outside temperatures. During the construction of the bridge atmospheric temperatures ranged from a low of 32 deg. below zero to a high of 83 deg.F.

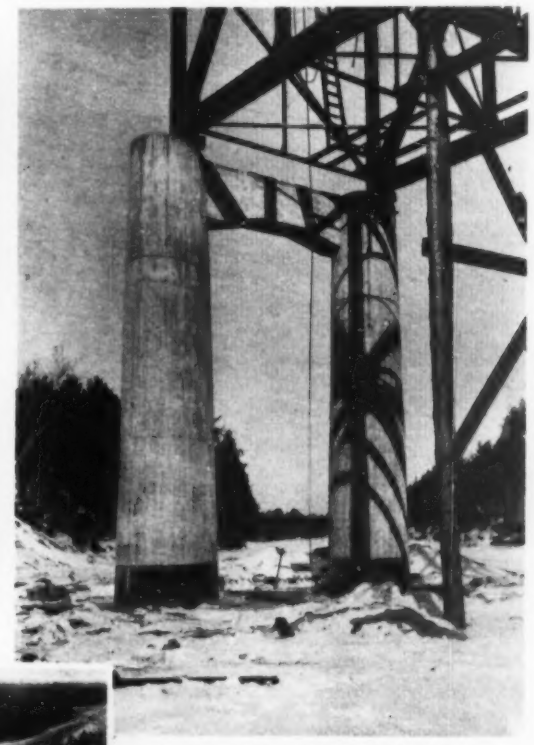
Administration—For the State Highway Commission of Wisconsin, E. L. Roettiger is state highway engineer and C. H. Kirch is bridge engineer. Information and illustrations for this article were furnished by Arthur O. Olson, assistant bridge engineer in charge of design and plans, and by J. I. Grann, assistant bridge engineer in charge of construction, with the cooperation of H. C. Helker, resident engineer on the project. The bridge was built by the Hoeppner-Bartlett Co., Eau Claire, Wis., contractor.



PIERS AND ABUTMENTS of Wisconsin bridge across Eau Claire River are concreted between Nov. 21, 1934, and Feb. 22, 1935. Temperatures during this period range as low as 32 deg. below zero, F.

PIER 2 is housed for 19 days following placing of concrete. Heat is turned off at end of 12 days.

FOOTING EXCAVATION precedes erection of column forms for pier 2. South abutment and pier 1 are housed in background.



AFTER GRADUAL COOLING to atmospheric temperature and removal of housing, pier 3 is ready for erection of steel.

COMPLETED BRIDGE carries traffic 8 months after start of construction Cold weather is not permitted to delay concrete work in State of Wisconsin.

ITEM	SOUTH ABUTMENT	PIER 1	PIER 2	EAST COLUMN	PIER 3 CROSS GIRDER	WEST COLUMN	PIER 4	PIER 5	NORTH ABUTMENT
Neat work poured	11-21-34	11-19-34	12-11-34	1-31-35	2-11-35	2-7-35	12-22-34	12-18-34	12-20-34
Temperature for day, deg.F.,	+29 +44	+41 +45	—15 +19	+23 +32	+21 +32	+17 +27	+15 +25	+25 +38	+14 +27
Heating Discontinued	11-28-34	11-26-34	12-22-34	2-20-35	2-20-35	2-20-35	1-3-35	12-25-34	1-1-35
Total Days Heated	8	8	12	21	10	14	13	8	13
Housing Removed	No record	No record	12-29-34	2-22-35	2-22-35	2-22-35	1-8-35	1-3-35	1-5-35
Total Days Housed	—	—	19	23	12	16	18	17	17

CUTBACK ASPHALT SURFACE, machine-finished, replaces old wood block pavement on 54-ft. width of Fourth St., in Portland, Ore., after removal of street car tracks.

Oregon's Black Top Paving Practice

By R. H. BALDOCK

State Highway Engineer of Oregon

DURING THE PERIOD from 1927 to 1932 the State of Oregon conducted a series of experiments toward the development of a non-skid back-top road surfacing. Summarizing the objective of the paving studies, the purpose has been to determine the mix that has the smallest amount of fines and the least asphalt that will effectively bind aggregates together and prevent penetration of moisture.

The experiment was further directed toward determining the maximum size of material that would appear on the surface. A certain degree of roughness is requisite to give the surface traction and develop tire friction, but there is a point beyond which the additional roughness causes unnecessary tire wear. It was, of course, found that if the surface was given too much asphalt it would bleed, but, on the contrary, a lean product would crack when subjected to heavy traffic.

Beginning with the specifications for asphaltic concrete that were standard ten years ago, the trial and error method was used to determine the proportion of the aggregate and asphaltic binder that would give best results. It was found that the major control is the amount and gradation of the fines, particularly the material between the 10- and 200-mesh and that passing the 200-mesh screen. The old specifications called for material using 34 per cent of the fines passing the 10-mesh screen. The asphaltic binder varied between 6½ and 8½ per cent. After a long series of practical tests, these percentages were reduced to 28 per cent passing the 10-mesh screen and the asphalt content was reduced to a range of from 4½ to 6½ per cent. In the first instance, of the material passing the 10-mesh screen, 4 to 7 per cent passed the 200-mesh. In the second instance, of the material passing the 10-mesh screen, 3 to 6 per cent passed the 200-mesh.

REMOVAL OF WOOD TIES of Fourth St. car tracks is done by hook and chain attached to dipper of skimmer scoop.

It was formerly the practice to cover the wearing course of old pavements with a flush coat of about 0.2 gal. of asphalt per square yard which, in turn, was covered with hot screenings ranging from ¼ in. to 10 mesh. This gave an excess of asphalt on the surface and finally resulted in a very slippery condition. Now, however, the new pavements are not covered with a flush coat but are further non-skidded by an application of coated screenings at the rate of about 7 to 12 lb. per square yard. The screenings are ½ to ¼ in. in size, coated with 2 per cent of asphaltic cement. The screenings are rolled into the pavement while it is still warm.

Investigations were also made of a more uniform non-skid type of wearing surface manufactured by mixing ¾-in. maximum size screenings with a cutback asphalt. The amount passing the 10-mesh, including the 200-mesh material, equals 14 per cent of the total

aggregate by weight. The cutback asphalt varies between 4 and 6 per cent.

Since the advent of the bituminous finishing machine Oregon has been putting down a very smooth type of asphaltic concrete. It was also found that the contractors reduced the cost because of the large output possible with the mechanical finisher. Two examples of recently constructed pavement using the cutback wearing surface are the resurfacing over old asphaltic concrete in the city of Medford and the resurfacing of Fourth St. in the city of Portland, Ore.

Early this year decision was reached to remove abandoned street car tracks on Fourth St. in Portland, and resurface a 54-ft. width (curb to curb) for a length of 3,120 ft. through the business district of the city. The wood-block paving on this street had been in need of attention for some time. After removal of the rails, the ties were cut in two with a pneumatic chisel in a jackhammer drill and by means of a hook attached to a skimmer shovel were quickly jerked out. Basalt headers along the rails and 4-in. wood blocks that constituted the previous pavement also were removed. After removal of the wood blocks the old concrete beneath was found to be in good shape and it was decided to leave it in place. The space occupied by the ties was filled with high-early-strength Portland cement concrete.

OLD CONCRETE BASE on Fourth St., after removal of wood ties, is leveled up by filling grooves with high-early-strength concrete and finishing with machine.

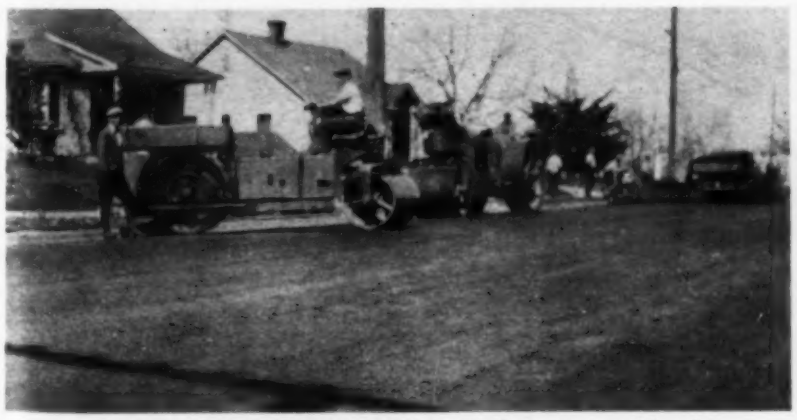
In building up the new surface the first move was to lay over the old concrete base a leveling course of asphaltic concrete 1½in. in minimum thickness. On this was placed a 1-in. finishing course of cutback wearing surface. A 22-ft. finishing machine made two trips over the pavement, finishing one-half width each time, and leaving a 5-ft. strip at each edge which was hand-raked.

PAVEMENT BURNER removes "fat" spots and high places in pavement at Medford, Ore.

BREAKS IN OLD SURFACING are first removed and patched in advance of regular paving.

DUMP TRUCKS at Medford deposit resurfacing mixture in front of strikeoff machine.

PAVING CREW places cutback asphalt wearing surface on one of Medford's streets.



ROLLERS CONSOLIDATE SURFACE. Tandem 5-ton machine does cross rolling and 3-wheel, 10-ton unit rolls longitudinally.

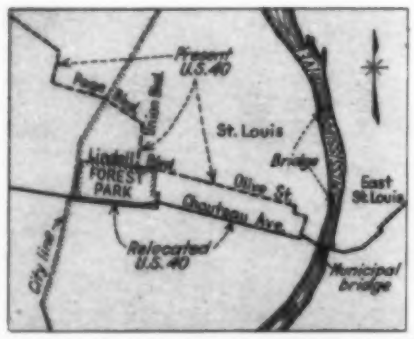
STRAIGHTEDGE tests smoothness of surface. Irregularities are detected by short lengths of brass chain spaced 6 in. apart.

EXPRESS HIGHWAY skirting southern boundary of Forest Park, St. Louis, will carry relocated U. S. 40 through western part of city. Fenced on both sides for entire length of 3 mi. and designed throughout with separated grade crossings for vehicles, pedestrians and equestrians, new roadway provides uninterrupted flow for through traffic. Clayton Ave. crossing (still in use in upper foreground) has since been replaced by Hampton Ave. overhead at center of modified cloverleaf intersection.

MISSOURI BUILDS EXPRESS HIGHWAY

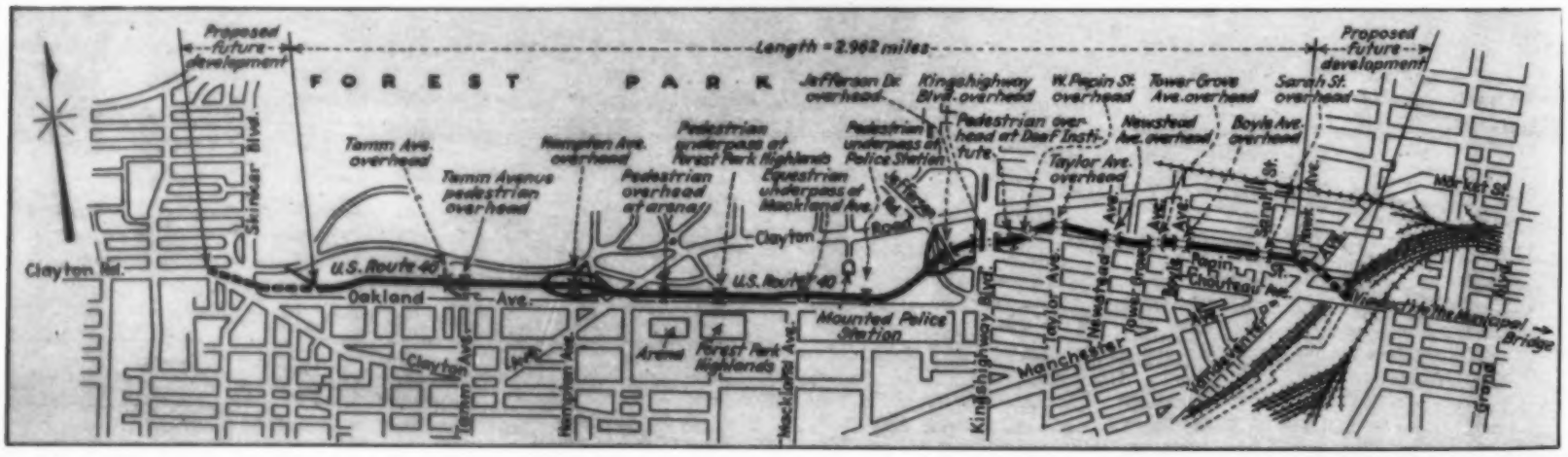
to Reroute U. S. 40 Through St. Louis

AN EXPRESS HIGHWAY 3 mi. in length, now under construction by the Missouri State Highway Department in St. Louis, will reroute U. S. 40 in the city, taking through traffic off overtaxed streets and putting it on a direct route to the Municipal Bridge across the Mississippi River. Sixteen grade separations, comprising both overheads and underpasses, are features of the improvement. At only two points in the 3 mi. of highway are there connecting ramps between the express route and the intersecting streets. The new pavement is 50 ft. wide, providing for five traffic lanes, except at these ramp connections, where the width is increased to 70 ft. A number of the overheads are rigid-frame designs in structural steel and in reinforced concrete. Within the limits of Forest Park, which the highway traverses for 2 mi., crossing



DIRECT ROUTE *(right)* for east-and-west through traffic on U. S. 40 is made possible by construction of new express road in western part of city connecting with Chouteau Ave.

SIXTEEN GRADE SEPARATIONS *(below)* involving number of interesting designs in overheads and underpasses carry vehicular, foot, and horse traffic across new express route.



STEEL GIRDERS on concrete bents carry roadway and two sidewalks on Hampton Ave. overhead.

RIGID FRAMES in steel *(above)* and reinforced concrete *(left)* distinguished structural designs of Jefferson Drive and Kingshighway Boulevard overheads.

RETAINING WALL of reinforced concrete is constructed in sheeted trench prior to excavation of east approach cut to Kingshighway overhead.

facilities for pedestrians, horses and motor vehicles are provided by appropriate underpasses and bridges. The right-of-way is fenced on both sides for its entire length in order to keep pedestrians and stray animals off roadway.

Location—Extending eastward for 3 mi. from the western city line, the new highway, for the first 2 mi. lies in Forest Park, close to and roughly parallel with Oakland Avenue, the southern boundary of the park. At the eastern end of the park the express route passes under Kingshighway Boulevard. Beyond this point it passes under seven other streets, and finally emerges to the surface at Hawk Ave. Future plans call for connection at the west end with Clayton Road by subway under Skinker Boulevard and at the east end with an existing Chouteau Ave. viaduct by an elevated structure. The location is indicated on the accompanying plan.

A second map shows how the new express highway will improve the alignment of U. S. 40 through St. Louis, eliminating a number of turns in the present route and relieving city streets of the burden of through traffic. Construction cost of the 3-mi. improvement, amounting to about $1,250,000, is being met with funds provided under the National Industrial Recovery Act. Right-of-way for the project is furnished by the City of St. Louis at an additional cash expenditure of about $500,000, making the total cost of the project about $1,750,000.

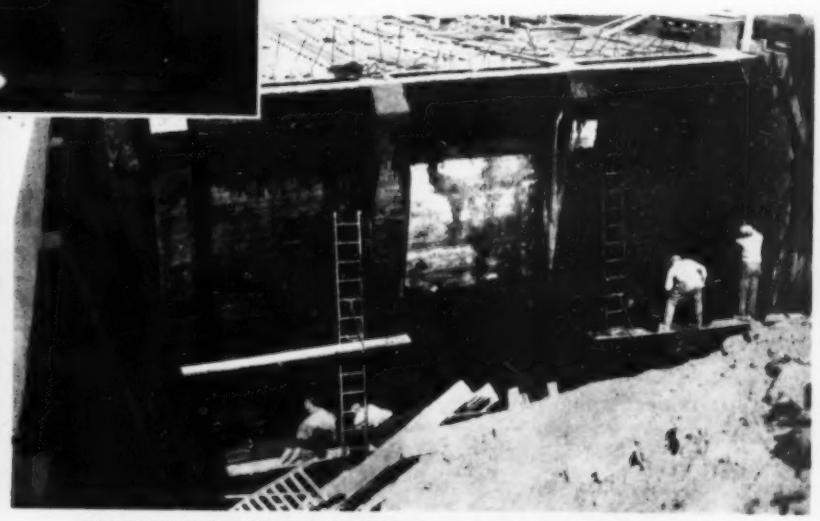
Features of Improvement—Among the most interesting structures involved in the project are two steel rigid-frame bridges in Forest Park, one at Tamm Ave. and the other at Jefferson Drive, and six reinforced-concrete rigid-frame structures to the east of the park, the largest of these being at Kingshighway Boulevard. Each of the rigid-frame bridges carries a vehicular roadway and two sidewalks. Two of them, in addition, carry double street-railway tracks. Other vehicular bridges utilize independent steel girder spans and steel-truss construction.

Three pedestrian overheads of interesting design lend structural variety to the project. One of these bridges is a three-span continuous plate girder structure, and the other two are designed as independent steel girder spans. All the pedestrian bridges are covered with welded steel-plate roofs to prevent icing of the walkways in winter.

Underpasses at three places in Forest Park, two for pedestrians and one for equestrians, add further variety to this unusual express highway. The underpasses consist of rectangular reinforced-concrete tunnels, thoroughly damp-proofed on the outside and lightened on the inside with white glazed tile and white portland cement paint. Pedestrian underpasses are designed with stairways at both ends for entrance and exit. At the equestrian underpass ramps on an 8-per cent grade, covered with asphaltic concrete for use by unshod horses, connect the tunnel with the surface.

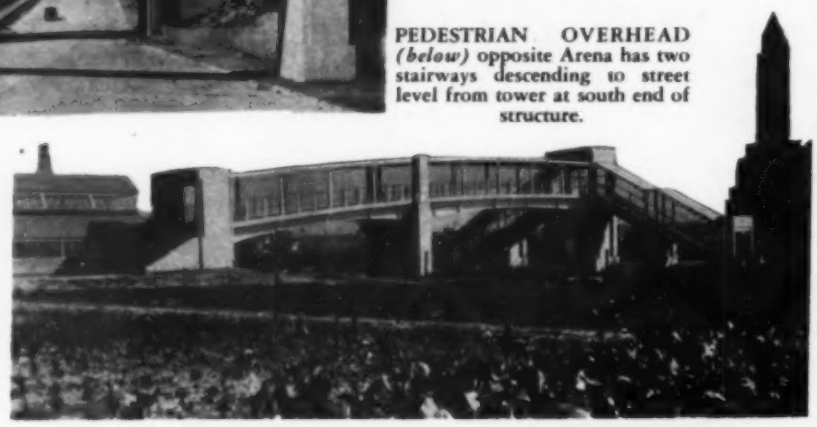
As indicated by the plan, access drives connect-

RIGID-FRAME CONSTRUCTION of reinforced concrete overhead at Kingshighway Boulevard. First half of structure has been completed to carry boulevard traffic during construction of second half.



BITUMINOUS WATERPROOFING is mopped on fill faces of counterfort U-abutments at Jefferson Drive.

STEEL RIGID-FRAME BRIDGE in background carrying Tamm Ave. across express highway is seen through central span of pedestrian overhead bridge.



PEDESTRIAN OVERHEAD *(below)* opposite Arena has two stairways descending to street level from tower at south end of structure.

ing the express highway with intersecting roads are provided only at Hampton Ave. and Jefferson Drive. Except at these access drives, where the width of the highway is increased to 70 ft., the pavement consists of five 10-ft. lanes. Monolithic white traffic lines made with white portland cement were cast in the pavement along the two edges of the center lane, and lip curbs along the two outside edges of the 50-ft. pavement also were constructed with white portland cement to mark clearly the limits of the paved surface. Cross-section thickness of the slab varies from 10 in. at the edges to 8 in. through the central portion of the 50-ft. width. The slab is reinforced with a steel mat.

Construction Contracts — A contract for the first seven structures in Forest Park, comprising two vehicular bridges, two pedestrian overheads, two pedestrian underpasses and one equestrian underpass, has been completed by the Fruin-Colnon Contracting Co., of St. Louis, at a cost of slightly more than $150,000. As may be noted by reference to the location plan, this contract includes the Tamm Ave. vehicular overhead at the west and the Police Station underpass at the east. Grading and drainage for this section of the highway, involving the excavation of 85,000 cu. yd. of earth, were completed by the Ansbro-Maguire Co., of St. Louis, at a cost of slightly less than $70,000. Paving in Forest Park and bridges at Jefferson Drive and Kingshighway Boulevard are being completed by the Webb-Boone Paving Co., of St. Louis, at a total cost, including roadway grading and drainage, of more than $345,000. Work on the grading, paving and structures east of Forest Park is now in progress by the Powers-Thompson Construction Co., of Joliet, Ill. This contract involves an expenditure of something more than $675,000.

Bridges in Forest Park—Of the three vehicular bridges within the limits of Forest Park, two are steel rigid-frame structures at Tamm Ave. and Jefferson Drive, with respective spans of 66 and 56 ft. The Tamm Ave. overhead is on a 24-deg., 38-min. curve. Both bridges have 32-ft. roadways and two 5-ft. sidewalks constructed with high-strength cement of 1:1.7:3 proportions.

As already noted, connecting roadways are provided at Jefferson Drive and at Hampton Avenue. The Hampton Avenue overhead consists of three independent steel-girder spans on concrete bents. The center span is 81 ft. long and the side spans are each 37 ft. long. High-strength concrete was used in the 50-ft. roadway and two 6-ft. sidewalks of this bridge.

Of the two pedestrian overheads, that at Tamm Ave. consists of three continuous plate-girder spans 34 ft., 58 ft., and 66 ft. long. The bridge has a concrete deck of high-strength concrete 6 in. thick and 8 ft. wide, which crosses the highway on a vertical curve of fairly steep slope. Above the deck is an electrically welded steel-plate roof supported by 6-in. H-section posts.

Opposite the Arena, which is St. Louis' convention and exposition center, a second pedestrian overhead crosses the express highway. This bridge is made up of two independent steel girder spans, one 43 ft. long and the other 54 ft. long, supported on concrete bents. The deck and the roof, 12 ft. wide, are similar in construction to the same features of the Tamm Ave. overhead. At the south end the bridge span is supported by a tower from which two stairways at right angles to the structure lead down to street level.

Kingshighway Overhead—At Kingshighway Boulevard a reinforced-concrete rigid-frame structure of 56-ft. span, 134 ft. in width, is being constructed one half at a time to avoid interruption of traffic on the boulevard. High-strength concrete is being used throughout in the construction of this bridge, with the exception of the railings. In addition to double electric railway tracks which are laid down the center of Kingshighway Boulevard, the bridge will carry two motor traffic drives. These drives are being paved with concrete and bituminous surfaces.

Foundations, Abutments and Wing Walls—Piers and abutments are founded on sound clay or shale rock. Abutments and retaining walls at Tamm Ave. and Kingshighway Boulevard are of cantilever design, but the approaches to the Jefferson Drive rigid-frame bridge are retained inside counterfort U-abutments. Fill faces of abutments and retaining walls were treated with a heavy mopping of bituminous waterproofing, and construction joints were further waterproofed by applying a strip of cotton fabric which was pressed into place in the hot asphalt for a distance of 6 in. on each side of the joint.

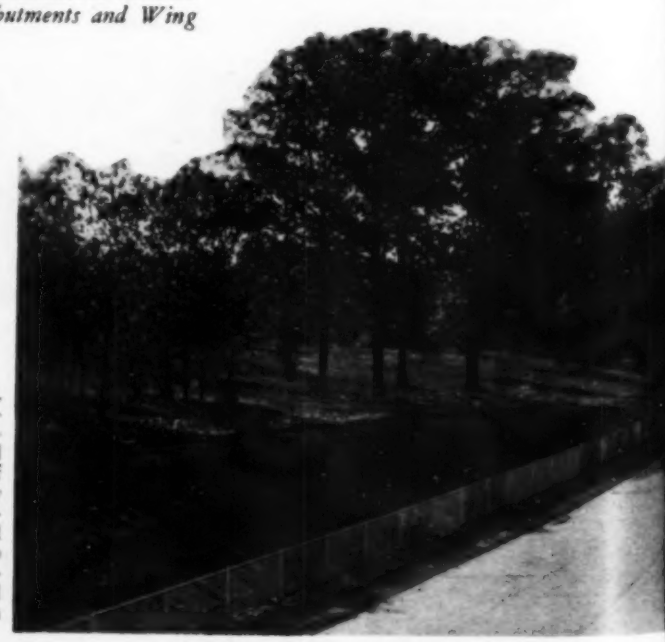
Underpasses—Two pedestrian underpasses cross beneath the express highway. Opposite an amusement plant called Forest Park Highlands is a pedestrian tunnel 53 ft. long and 12 ft. wide, connected with the surface at each end by a pair of diverging stairways at right angles to the barrel. Between Oakland Avenue and the express highway at this point is a double-track street-railway line. A covered platform for trolley passengers was placed between the stairway entrances at the south end of the underpass. In the tunnel itself the south end had to be depressed to pass beneath a 50-in. water main.

At the Police Station is a second pedestrian underpass with a barrel 59 ft. long by 8 ft. 2 in. wide and with a single stair entrance at each end.

Between the two pedestrian underpasses is an equestrian underpass opposite Mackland Avenue. A number of stables along this street rent saddle horses for use on the park bridle paths. The underpass consists of a rectangular barrel, 53 ft. long by 12 ft. wide, with an open ramp at each end. Both the ramps and the floor of the tunnel are paved with a 5-in. base course of portland-cement concrete covered with a 1-in. asphaltic concrete wearing surface.

Methods of Construction—In building the eight structures in the park and at Kingshighway Boulevard, the Fruin-Colnon Contracting Co. and the Webb-Boone Paving Co. depended for production of concrete upon 1-yd. paving

THREE-SPAN FOOTBRIDGE *(left)* at Tamm Ave. gives pedestrians access to Forest Park from Oakland Ave. Unbroken fences on two sides of roadway prevent trespassing on pavement.



WELDED STEEL ROOF *(below)* supported on steel H-columns is designed to prevent icing of footbridge walkway which crosses highway on vertical curve of fairly steep slope. Sides are inclosed by steel guard rail and chain link wire mesh.

mixers to which dry batches were delivered by trucks from commercial plants. At its bridges and underpasses, the first-named contractor constructed forms for piers and walls with 1x8-in. sheathing on 2x6-in. studs, spaced on 16-in. centers. Wales consisted of double 2x6-in. pieces, 16 ft. long, with 1-in. separators between the 2x6's to provide space for tierods.

Wall forms were tied with Tyscrus. In the case of a 12-in. wall, each tie consisted of a 10-in. separator with a 1-in. removable metal cone on each end, providing a combination spreader and tie for the 12-in. wall.

All exterior surfaces on the Fruin-Colnon contract were lined with ¼-in. Masonite Presdwood composition board, which was re-used an average of one time only. In the construction of heavy columns, such as those at the Hampton Ave. bridge, the forms were tied with ⅜-in. soft steel rods, threaded at the ends and locked with eccentric-holed, thumb-screw-type clamps.

Concrete in footings and piers was placed with bottom-dump buckets handled by a crawler crane. Beams, walls and decks were concreted with hand buggies. As required by specifications, all structural concrete was vibrated, the contractor using one or two Mall gasoline-powered vibrators for this purpose. When placing concrete in 12-in. reinforced walls, the constructor used a 12-in. cylindrical canvas chute to prevent segregation.

Exposed concrete surfaces were finished by hand-rubbing in two operations to produce the smooth, uniform texture specified. For the first rubbing the workmen used coarse-grained carborundum bricks to give the surface a uniform texture. The surface then was brought to a smooth finish by a rubbing with fine-grained carborundum brick.

Similar methods of concreting were utilized by the Webb-Boone Paving Co. at Jefferson Drive and Kingshighway Boulevard, with the exception that plywood form lining was used instead of Masonite on exposed concrete surfaces. At Kingshighway Boulevard, the contractor closed the west roadway and excavated an opening in this portion of the street to permit construction of the first section of the reinforced-concrete rigid frame. The street railway tracks were carried on steel stringers supported by timber piles. Following completion of the first section of the bridge, boulevard traffic was diverted to the west driveway, and the contractor built that portion of the bridge supporting the east roadway.

In excavating for its three underpasses, the Fruin-Colnon Contracting Co. drove steel sheetpiling around the cut and braced it securely to hold the soil, of a moist fire-clay nature, against slippage. The sheetpiling was driven about 8 in. beyond the outside dimensions of the concrete structure to permit erection of wall forms. Fill surfaces of the underground structures were treated with three moppings of bituminous waterproofing and two layers of impregnated fabric.

Forest Park Paving—A single 27-E paving mixer, supplied with dry batches by trucks from a commercial plant, laid 71,000 sq. yd. of pavement on the Webb-Boone contract in Forest Park. In working on pavement of 50-ft. width, the contractor laid two 20-ft. lanes and one 10-ft. lane. As required by Missouri specifications, the subgrade was covered with a waterproof building paper to prevent loss of moisture into the soil and to decrease subgrade friction. Curing was accomplished by covering the surface with waterproof Sisalkraft paper. This paper was used in long strips, about 10 ft. wide, which were rolled on pole handles for transfer from one section of pavement to the next. The rolls of kraft paper were used repeatedly for the curing process, due care being exercised to see that all holes or tears were patched.

Disposal of Spoil—Almost 500,000 cu. yd. of excavation is involved in the construction of the express highway. Most of this soil is being utilized to build up the embankments of a proposed stadium which eventually will take shape in a natural depression in Forest Park just west of Jefferson Drive.

Construction East of Park—East of Kingshighway Boulevard, the Powers-Thompson Construction Co. is operating four power excavators to remove 250,000 cu. yd. of excavation and to dig trenches for relocated sewers and other utilities. Sewers of precast concrete pipe and of tile-lined monolithic construction are being rebuilt and relocated. At one of the intersecting streets, a trolley line is by-passed around the site to permit bridge construction.

FORM LINING of composition board aided construction of difficult concrete design at equestrian underpass opposite Mackland Ave.

Seven structures are to be built under this contract east of Kingshighway Boulevard. The first is a pedestrian overhead connecting the Central Deaf Institute with a playground for the deaf children. This overhead is similar to the other footbridges, with a 7-ft. 10-in. walkway on steel girders covered by a welded steel-plate roof.

At the new crossing of West Papin St. is the only truss bridge of the entire project. Two 125-ft. steel trusses on concrete abutments support a 36-ft. roadway and two 8½-ft. sidewalks. As the structure intersects the street on a skew of 61 deg. 27 min., construction of the bridge is somewhat complicated.

Overhead structures carrying the remaining five streets over the express highway consist of rigid-frame reinforced-concrete bridges in span lengths varying from 55 to 63 ft. Each bridge will carry a 36-ft. road and two 6-ft. sidewalks. Special high-strength concrete, of 1:1.9:3.4 proportions, compacted by mechanical vibrator, is specified for the rigid-frame span of each bridge. Similar high-strength concrete is to be placed in the deck of the West Papin St. truss bridge. All fill faces of bridges, bridge wings and retaining walls are to be damp-proofed.

Administration—T. H. Cutler is chief engineer of the Missouri State Highway Department, and D. B. Levi is engineer of construction. Under the general supervision of P. H. Daniells, division engineer, Kirkwood, Mo., and C. C. Tevis, division construction engineer, the work on the express highway is directed by W. L. Chandler and J. D. Lester, project engineers.

EQUESTRIAN UNDERPASS has open-ramp approach at each end of rectangular tunnel under highway.

PEDESTRIAN UNDERPASS *(right)* opposite amusement plant has pair of stairways with covered entrances at each end of tunnel. Between entrances at far side of highway is covered platform for trolley passengers.

FIVE-LANE CONCRETE PAVEMENT has monolithic white-cement traffic lines at two edges of center lane. Lip curbs at both edges of 50-ft. width also are made with white cement. Continuous wire-mesh fencing on both shoulders keeps pedestrians and stray animals off roadway.

STAIRWAY *(below)* of pedestrian underpass, with handrails lined up for attachment to walls. White glazed tile and white portland cement paint brighten walls of underpasses.

Present and Accounted For —

A Page of Personalities

DUDLEY T. CORNING will serve during 1936 as president of the City Officials Division of the American Road Builders' Association. Mr. Corning is chief of the Bureau of Highways, Department of Public Works, Philadelphia, Pa.

COLONEL WILLARD T. CHEVALIER, vice-president of the McGraw-Hill Publishing Co. and publishing director of *Construction Methods* and other civil engineering and mining papers, becomes president of the American Road Builders' Association this month. For the last five years he has been president of the Highway Industries Association, manufacturers division of the A.R.B.A., and is a past-president of the New York Section of the American Society of Civil Engineers. With the 11th U. S. Engineers in France during the World War he served successively as captain, major and lieutenant-colonel.

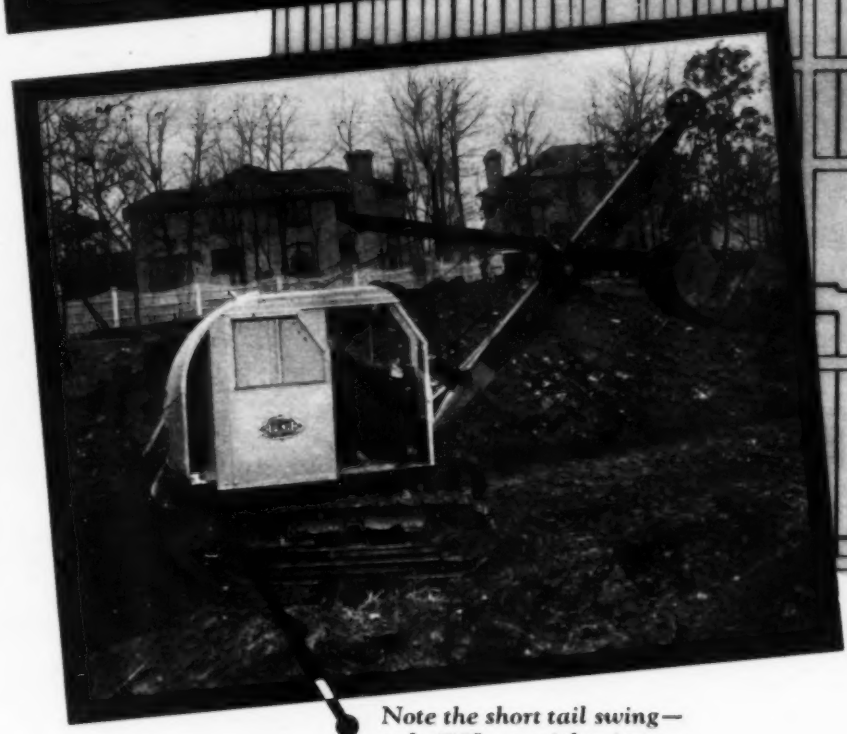
J. W. MAVITY has been named president of the County Highway Officials Division of the American Road Builders' Association. Mr. Mavity is county engineer of Harvey County, Kansas, with headquarters at Newton.

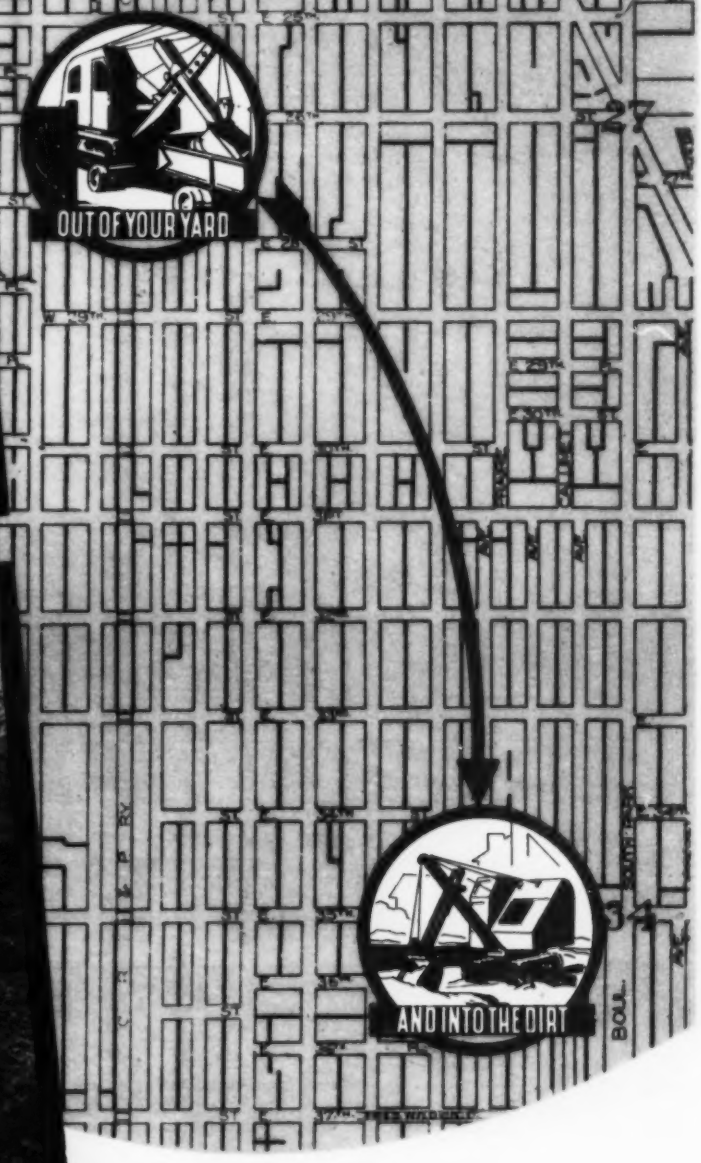
DANIEL W. MEAD, consulting engineer, of Madison, Wis., takes office this month as president of the American Society of Civil Engineers. For 28 years, beginning in 1904, he served as professor of hydraulic and sanitary engineering at the University of Wisconsin. As a member of the firms of Mead & Seastone, of Madison, Wis., and of Mead and Scheidenhelm, of New York City, he has been engaged, as consultant, on a wide range of hydraulic works and power plants, including membership on the Colorado River Board and the Board of the Sanitary District of Chicago.

GEORGE H. DELANO has been named acting chief engineer of the Massachusetts Department of Public Works, succeeding Arthur W. Dean who resigned recently after 22 years of continuous service to become chief engineer of the newly created Massachusetts Planning Board. Mr. Delano, for the last 12 years, has been maintenance engineer of the department, and before that was district engineer.

WILLIAM A. KLINGER this month succeeds Nick F. Helmers, of St. Paul, Minn., as president of the Associated General Contractors of America. Mr. Klinger is president of William A. Klinger, Inc., of Sioux City, Ia., and has specialized in building and bridge construction.

OUT OF YOUR YARD AND INTO THE DIRT —*QUICK!*





Note the short tail swing—only 7'8"—a mighty important factor in any small job and many big ones.

That's what counts in a small-job business. And 1936 is a year of small jobs . . . a home-building, basement-digging year. A job here . . . a job there . . . all over the map. There's real money ahead for the man who's equipped to get to his job fast, dig fast, and hustle on to the next one. That's why so many contractors are buying Bantam-Weights. You can haul 'em half way across town, excavate a basement, and get away to the next job in less time than it takes to get a big, cumbersome machine well started. Bantam-Weights are the fastest things on cats. They're built with new high tensile alloys for lightness and strength . . . they're powered with the husky Ford V-8 motor . . . they're as modern as streamlined trains. If you want to get set for bigger profits from small jobs, take a look at the Bantam-Weight.

HARNISCHFEGER CORPORATION

4494 W. NATIONAL AVE. *Established 1884* MILWAUKEE, WISCONSIN

Warehouses and Service Stations: Hoboken, Memphis, Jacksonville, Seattle, Dallas, Los Angeles, San Francisco

P&H BANTAM WEIGHT

FIRST TO THE JOB — AND FIRST THRU

ONE OF THE 22 P&H PACEMAKERS FOR 1936

(Above) On the job with an Alemite Volume Gun, designed to deliver a large volume of lubricant quickly to large-cavity bearings. Lubricant delivery is 1 1/5 oz. per stroke of the handle. Lubricants handled: Regular, Fluid, and Viscous. Excellent for tractor track rolls.

(Below) Lubricating on the job with an Alemite Gat Gun equipped with Ball-Jointed Hose. Extremely high pressures can be developed by pumping the lever handle. You *know* the lubricant is being forced into the bearing. And when you use Alemite Lubricants you *know* your equipment is protected against friction and wrenching strains.

DON'T WORRY ABOUT MUD and CLAY!

Alemite Provides Positive Pressure—Insures Thorough Lubrication

When you lubricate your equipment, do you *know* each bearing receives the lubricant it really must have? And when your machines are caked with dirt, do you *know* the lubricant reaches those unseen shafts and moving parts?

End your worries with Alemite! For no matter what conditions you have to put up with, Alemite Systems provide exactly the lubricant pressure required to keep your equipment fully protected from destructive friction. And no matter what kind of work you're doing—no matter what type of machinery you use, there's a low-cost Alemite way to insure thorough lubrication.

And Alemite has developed a complete line of extreme-pressure lubricants — lubricants that withstand terrific strains and loads, and keep your equipment on the job week in and week out.

IN THE SHOP AND ★ ON THE JOB

(Above) Alemite Powergun Lubrication Equipment mounted on a truck. It brings amazing savings in on-the-job lubrication.

(Left) In this shop an Electrically-Operated Alemite "Rock Crusher" Powergun is dispensing heavy, fibrous lubricant.

Alemite Saves You Money

Whether you lubricate your machinery on the job or in the shop, you'll save time, labor and lubricant with Alemite Equipment and Alemite Temprite Lubricants. And best of all —you'll *know* your equipment is protected against friction!

New Free Handbook

Let us send you our newest handbook—"The Case of Alemite vs. Friction." It's free!

ALEMITE—*A Div. of Stewart-Warner Corp'n.*
1840 Diversey Parkway Chicago, Illinois
Stewart-Warner-Alemite Corp'n. of Canada, Ltd., Belleville, Ontario, Canada

ALEMITE
REG. U. S. PAT. OFF.

Equipment and Lubricants For Heavy Duty

AIR COMPRESSOR HEADQUARTERS

BOOTH F-9

visit

SCHRAMM

at the

CLEVELAND

ROAD SHOW

January 20th to 24th

See the worlds most modern

PORTABLE AIR COMPRESSORS

SCHRAMM, INC. - - - - WEST CHESTER, PA.

Roebling...

The pacemaker in wire rope development

THE most exacting basis for judging wire rope performance is AVERAGE SERVICE.

This is the basis advocated by Roebling, in which rope cost per ton of material handled, or per other unit of service measurement, is based not on the service of a single rope but on the *average* service of several ropes.

John A. Roebling's Sons Co., Trenton New Jersey

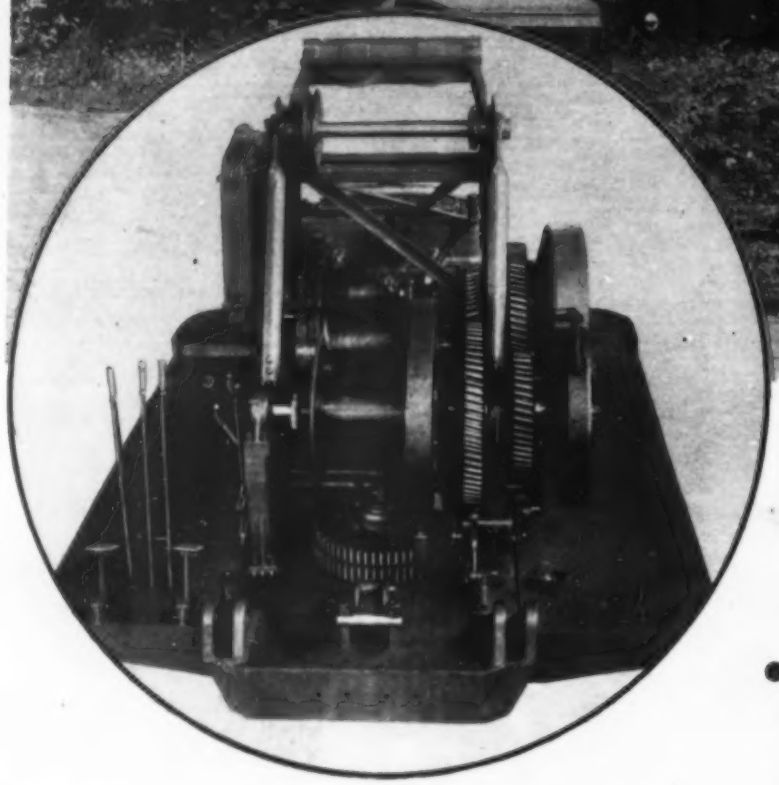
At the Road Show — don't miss the Athey Forged-Trak Side Dump Quarry Trailer!

"THEY SURE CAN ROLL!"

● When the dipper swings and the going is tough, there's only one Forged-Trak! See Athey Forged-Trak Side Dump Quarry Trailers in action. Watch them roll the earth and rock away. Watch them "make time" over rough ground in any kind of weather—notice the quick, clean dumping to right or left. Then you'll know why Athey Forged-Trak Side Dump Quarry Trailers are FIRST choice wherever hauling efficiency is measured in *more yards per day, every day.*

ATHEY TRUSS WHEEL CO.
5631 West 65th Street, Dept. J, Chicago, Illinois
Cable Address: "Trusswheel" Chicago

ATHEY
Forged-Trak
REG. TRADE MARK



25 REASONS for CHOOSING a BAY CITY

(10 MODELS — ⅜ to 1¼ yd.)

1—Convenient economical weight.
2—Helical cut gears—noiseless, long wearing.
3—Unit (nickel-manganese) car body and machinery table, totally heat treated.
4—Frictionless bearings thruout.
5—6-cylinder power.
6—Extra large diameter swing roller-path.
7—Oversized clutches and brakes.
8—Drop forged crawler shoes.
9—Long crawlers—low bearing pressure.
10—Chain crowd with automatic adjustment.
11—Swing lock—in any cab position.
12—Automatic Travel lock.
13—Extra heavy cab. Plenty inside working room.
14—Fast operating speeds.
15—Two travel speeds.
16—All steel construction.
17—Three lever control.
18—E-Z clutch control.
19—High pressure lubrication thruout.
20—Safety worm boom hoist.
21—Separate hoist drums.
22—Internal swing teeth.
23—Unequalled steering at full speed.
24—Convertible—without machinery change.
25—Accessibility for inspection or adjustment.

BAY CITY *design features mean* MORE YARDAGE

● Sturdy, tough and dependable, yet never extreme, Bay City design offers economy of operation and upkeep. Note for instance, the machinery assembly illustrated at the left. Tandem drums with more cable surface permits straight cable lead from drums with any boom or bucket, thus avoiding undue cable wear without off-center pull. Helical cut alloy steel gears insure quiet, smooth operation and longer life. This efficient machinery arrangement and design is standard on all Bay City full-revolving models.

Before you buy your next shovel, compare Bay City construction materials, design, accessibility, speed, working ranges and safe load capacity with any machine in the same capacity or weight class. You can't beat Bay City value regardless of what you pay. Convertible Bay City equipment, with standardized design, incorporates the best construction features, eliminating surplus dead weight, thus adding to productive yardage and effecting lower costs.

• • •

first public showing

At the ROAD SHOW

Cleveland, Jan. 20-24, 1936

See the NEW BAY CITY

⅜-yard — Full Revolving

A 10-ton machine that can really "take it." All modern features of design and unit castings. Strength and sturdiness not sacrificed for light weight or price.

Also

Model 62 — one yard Diesel shovel

BAY CITY SHOVELS Inc. Eastern Offices, Roselle, N. J. BAY CITY, MICH.

GOING to the SHOW?

Look in on the GALION EXHIBIT.

They're trekking to Cleveland . . to the Annual Road Show . . to see just what has been accomplished in a Road Machinery way during the past year.

Flash . . do not fail to visit *Space E-10,* where Galion is utilizing some 2000 sq.ft. of floor space to show you the latest developments in Road Graders and Rollers.

To rightfully ascertain from whom you should buy . . see these newest and most advanced models which are destined to set the pace in 1936:

1. Galion Portable Roller.
2. Galion Tandem Roller.
3. Galion "Chief" Road Roller with "Roll-A-Plane" Attachment.
4. Galion Diesel Powered Motor Patrol Grader.
5. Galion No. 12 Leaning Wheel Grader with Hydraulic Control.

(Three of these new developments are illustrated here).

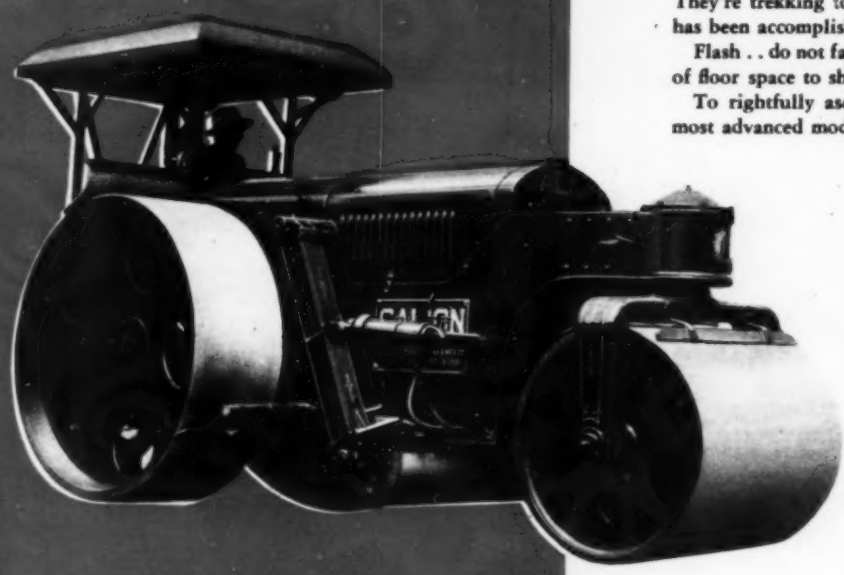
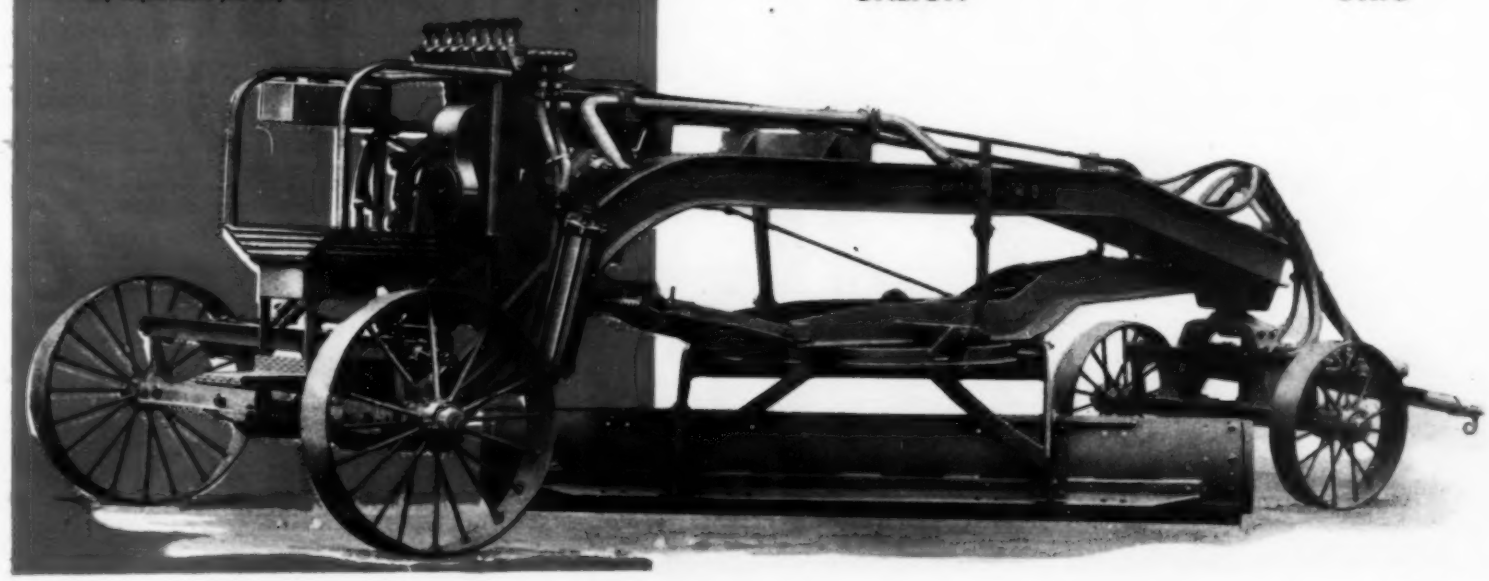


Illustration (right-above) shows the New Galion Portable Roller. It is a low cost machine of great versatility . . suitable for rolling patch material, for compacting loose material, rolling drives, etc. Portability is one of its outstanding features.

Illustration next above shows the Galion "Chief" Road Roller with the New "Roll-A-Plane" attachment. Also equipped with Hydraulic Steering and Scarifier. Built in 10 and 12 ton sizes. Also Galion "Warrior" Road Rollers in 5, 6, 7 and 8 ton sizes.

Galion No. 12 Leaning Wheel Grader (below) equipped with Hydraulic Control. All adjustments on this big Grader are instantly made at the touch of the finger. There is a size and type Pull Type Grader in the Galion line to meet any requirement you may have.



After you have seen and have carefully inspected these New Galion Machines . . we invite you to compare them with other makes. We want you to find out for yourself how much more you get for your money when you buy Galion. Literature on request.

THE GALION IRON WORKS & MFG. CO.

GALION **OHIO**

"Your FINISHER"

Your best bet is the FLEX-PLANE 20" wide screed finisher. Screeds forward and backward rapidly. Better work, better roads, smoother surface at lower cost. Adjustable throughout for various widths. Best by use and contest.

Also Joint Installers and Combined Expansion Joint and Dowel Bar Spotters.

FLEXIBLE ROAD JOINT MACHINE CO.
Warren, Ohio

See us at the ROAD SHOW Booth E-11

TRUKMIXER BATCHING PLANTS
BULLDOZERS
ROAD FINISH SPREADERS
BATCHERPLANTS MANUAL OR AUTOMATIC
BLAW-KNOX
STEEL STREET FORMS
DIRTMOVERS
ROAD FORMS
BLAW-KNOX LEADERSHIP CONSTRUCTION EQUIPMENT
STEEL FORMS FOR GENERAL CONCRETE CONSTRUCTION
CEMENTING
TAMPING ROLLERS
CENTRAL MIXING PLANTS
CONCRETE BUCKETS
STEEL BUILDINGS
STEEL GRATING
TRUKMIXERS AND AGITATORS
BULK CEMENT PLANTS
CONSTRUCTION EQUIPMENT
To Fulfill Contracts Speedily and Profitably
New developments and improvements in Blaw-Knox Construction Equipment are right in step with today's program.
With a background of years of practical experience, Blaw-Knox equipment is trustworthy. It is economical and low in maintenance. Designed to stand up under severe operating conditions, it is fitted to the job by skilled engineers. It helps immeasurably to fulfill contracts speedily and profitably.
BLAW-KNOX COMPANY, 2086 Farmers Bank Building, Pittsburgh, Pa.
Offices and Representatives in Principal Cities
Visit the Blaw-Knox Exhibit at the Road Show—BOOTH D-14
CLAMSHELL BUCKETS
GAS-ELECTRIC ROAD FINISHERS

Who's Afraid

of the

BIG BAD SNOWMAN

Erecting large Armco Multi Plate Arch under state trunk highway in Minnesota. The temperature went to 14 degrees below zero during the construction of this bridge.

ROAD BUILDERS have learned by experience that "shutting down for winter" is largely *a fairy tale.* In fact, there are sound reasons for pushing ahead with drainage installations, on roads which are scheduled for improvement next spring. Here are just a few.

By completing your structures this winter, the way is cleared for grading operations. Equipment and materials can be moved as needed and work can be done as a unit, instead of "piece-meal." In addition, maintenance due to settling fills is practically eliminated because your fills will have several months to settle before the surfacing is applied. Even more important, winter work provides employment when labor really needs a job.

So put in your culverts and small bridges this winter. By using Armco corrugated pipe and Multi Plate, you can depend on completed jobs of *known quality*—even under the most severe working conditions. And remember, too, that Armco engineers are always at your service.

ARMCO CULVERT MANUFACTURERS ASSN.
Middletown, Ohio

Play Safe

USE METAL

ARMCO

CORRUGATED PIPE • MULTI PLATE • METAL CRIBBING

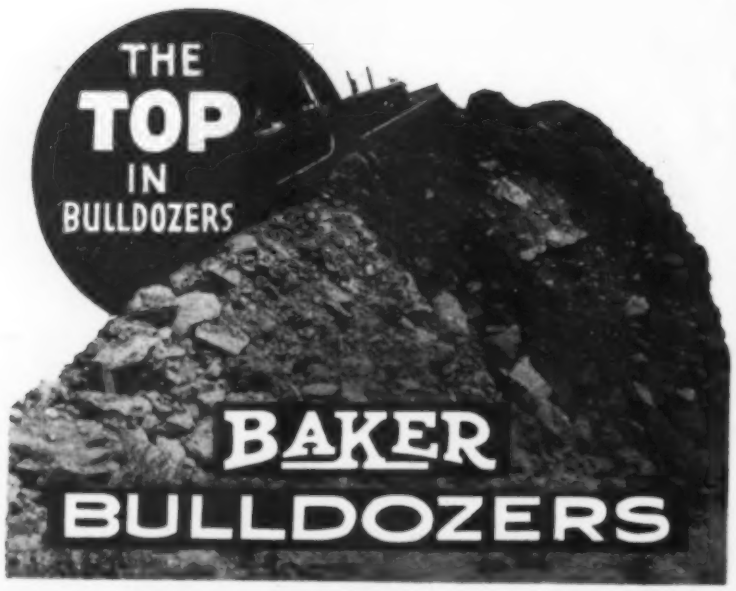
☐ Please send me your latest free catalog on Armco MULTI PLATE.

Name.....

Title.....

Street.....

City.....CM-1



Start at the top when you select Bulldozers for that job. Baker Direct Lift, Twin Cylinder Bulldozers are "plenty tough" for the hard jobs yet have that accurate control and easy operation so essential to good bulldozing work.

They are simply constructed. Direct lift operation eliminates gears, cranks or levers to cut down the number of fast wearing parts. This saves you money on repair bills; correct mounting makes them easy on your tractor, saving wear and tear.

That's why many leading contractors have as many as twenty Baker Bulldozers in their equipment. Investigate Bakers.

See The Baker Exhibits at

ROAD SHOW

CLEVELAND

January 20-24, 1936

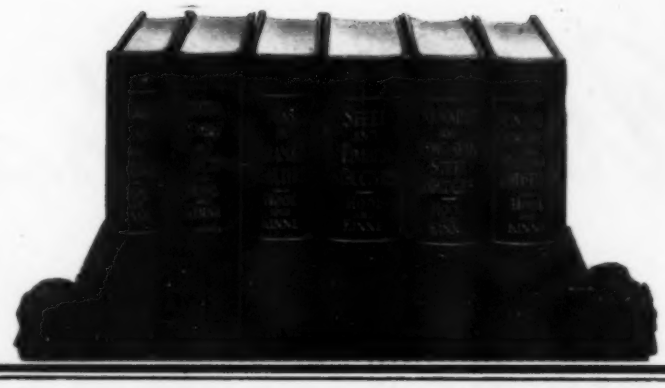
Ask For Bulletins on Bulldozers and Other Baker Equipment.

THE BAKER MANUFACTURING CO.,

568 Stanford Avenue, Springfield, Ill.

BAKER TRACTOR EQUIPMENT
EARTH MOVING-ROAD MAINTENANCE-SNOW REMOVAL

BULLDOZERS
GRADEBUILDERS
TRACTOR SCRAPERS
ROAD ROOTERS
ROAD DISCS
SNOW PLOWS



Answers to your problems in structural engineering always at your finger tips

EVERY man concerned with the design and construction of civil engineering structures of any type should have these practical books with their helpful tables, diagrams, reference data, best methods and details.

Hool and Kinne's

Structural Engineers' Handbook Library

6 Volumes—3575 pages—fully illustrated

The most valuable library obtainable for any man concerned with the design and construction of civil engineering structures of any type.

Under the general editorship of George A. Hool, formerly Professor of Structural Engineering, University of Wisconsin; and W. S. Kinne, Professor of Structural Engineering, University of Wisconsin, Editors-in-Chief of the Library, *Sixty-Six* of the leading, practical operating structural engineers of the United States and Canada give you the very cream of their knowledge of structural engineering.

They give you six well bound, fully illustrated volumes, containing 3,575 pages of practical, authoritative information covering every phase of structural engineering from foundation and substructure work to the completed erection.

Every man concerned with the design and construction of civil engineering structures of any type should have these practical books with their helpful tables, diagrams, reference data, best methods information and details. The six books are:—1. Foundations, Abutments and Footings. 2. Structural Members and Connections. 3. Stresses in Framed Structures. 4. Steel and Timber Structures. 5. Movable and Long-Span Steel Bridges, and, 6. Reinforced Concrete and Masonry Structures. With these books on hand you cannot make mistakes.

By placing this Library on your bookshelf you are putting within arm's reach years of actual first rate experience with structural problems. Do not forget either, that these men are all EXPERTS in their lines.

10 DAYS' FREE EXAMINATION

Send us the coupon below, properly filled in, and we will send the Library to you for 10 days' FREE examination. If you examine the books carefully you will want to keep the Library. In that case just send us $3.50 and then $3.00 per month until the total price of $27.50 has been paid.

McGRAW-HILL FREE EXAMINATION COUPON

McGraw-Hill Book Company, Inc., 330 West 42d Street, New York.

You may send me **Hool and Kinne's Structural Engineers' Library** for my inspection. If the books prove satisfactory, I will send $3.50 in 10 days and $3.00 per month until I have paid the price of the books, $27.50. If the books are not what I want, I agree to return them postpaid within 10 days of receipt.

Signature .....

Home Address .....

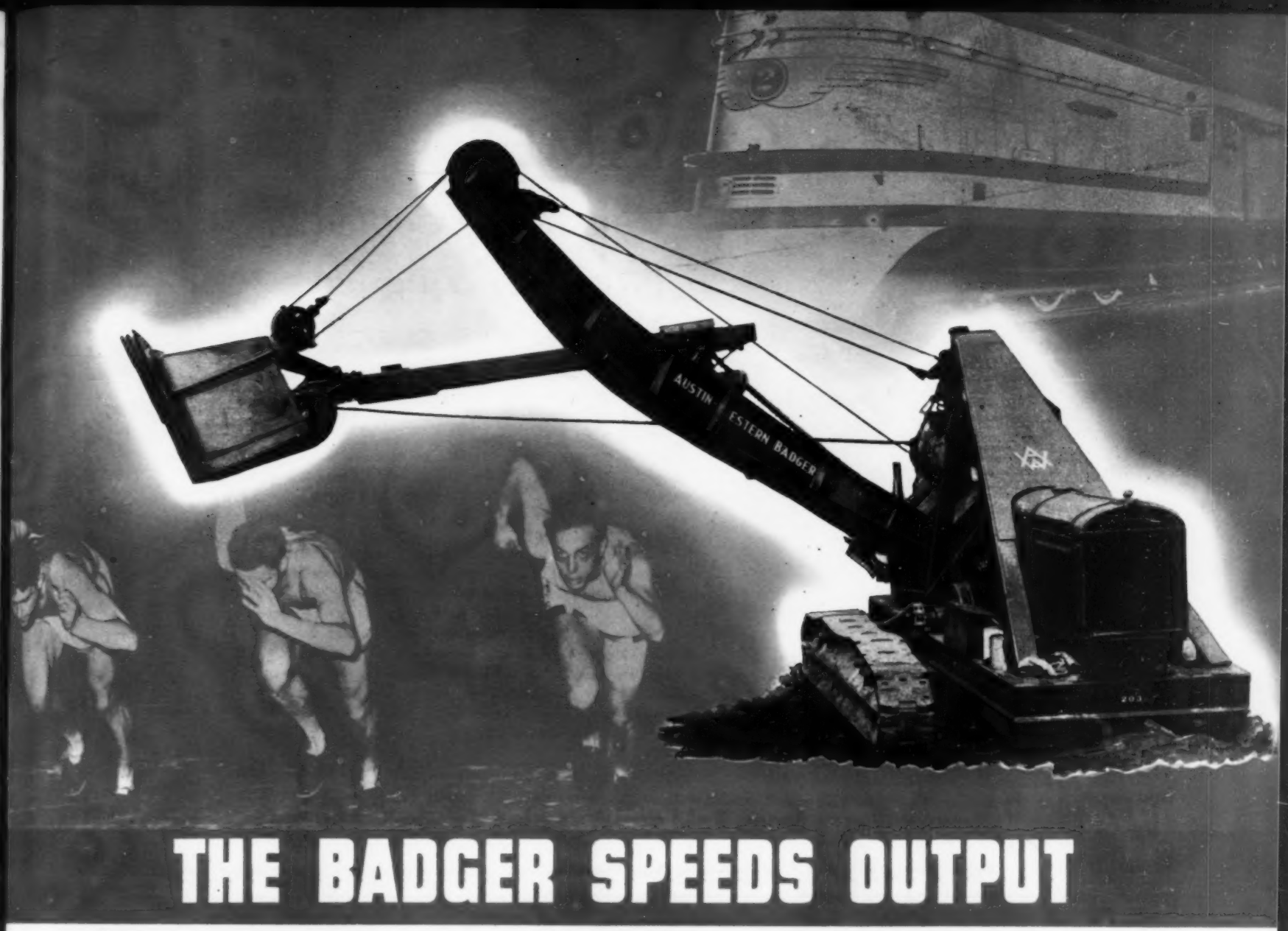
City and State .....

Name of Company .....

Occupation .....

(To insure prompt shipment write plainly and fill in all lines.)

CM-1-36



THE BADGER SPEEDS OUTPUT

Acme

Its Light Swinging Structure Is Free from Dead Weight. Larger Bucket . . . Starts . . . Stops Faster

This Badger turns out the work.

P. C. Roth, Minn., writes: "Piled 1600 tons gravel in 10 hours."

W. R. Sexton, Georgia, says: "Don't think it could be beat."

B. B. McCormick & Sons, Fla., reports: " . . . so far beyond expectations we checked and re-checked the job."

That's the kind of thing this faster moving ½-yard Badger does on job after job.

And here's why. It's fast—starts—stops far more quickly.

THE BADGER SHOVEL

offers a combination of speed, cubical capacity, and rugged construction which makes its output greater than shovels of the same or even larger rated capacity.

Why faster? The motor does not swing with the boom. The boom bucket and dipper stick are of light alloy steel construction, and the weight saved permits full ½-yard dipper capacity. Yet even with this increased pay load the total weight of these parts is lighter than before.

41 anti-friction bearings between motor transmission and dipper sheave.

Transportation at motor truck speeds on its own wheel mounts.

Write for new Shovel Bulletin to be out soon.

The Austin-Western Road Machinery Co.

Home Office: Aurora, Illinois Cable Address: AWCO, Aurora

Branches in 14 Principal Cities

Austin-Western

ROAD GRADERS · MOTOR GRADERS · ELEVATING GRADERS · DRAGS
ROAD ROLLERS · DUMP WAGONS · DUMP CARS
SCARIFIERS · BULLDOZERS · TRAILERS · SCRAPERS · PLOWS
BITUMINOUS DISTRIBUTORS · ROAD-MIX MACHINES · CULVERTS
CRUSHING AND WASHING PLANTS · SWEEPERS AND SPRINKLERS · SHOVELS · CRANES · ETC · SNOW PLOWS

The Austin-Western Road Machinery Co.
A-6, Aurora, Illinois
Send me the new Badger Shovel Bulletin.

Name .....
Address 604
City .....*State*.....

Genuine O. AMES

Constantly Copied... but never equalled

THE SHOVEL THAT BUILT AMERICA

EVERY contractor wants tools that give longer service, but lighten and speed up the work. When it comes to shovels the Genuine O. Ames fulfills these requirements.

For one hundred and sixty-one years this Plain Back Shovel has been the leader in its field. The famous Ames Bend, giving a perfect balance and a sense of lightness, is one feature that is a distinctive help in shoveling.

The time-tested special (1) Alloy Steel embodying Ames' successful attainment of the perfect compromise between hardness and flexibility, the (2) electric welded straps, the (3) selected XXX Quality highest grade second growth Northern White Ash handles and the (4) Armor-D handle grip, are reasons why Genuine O. Ames cuts the cost of both the shovels and shoveling.

Furnish your men with Genuine O. Ames, the shovel with that good "Feel", you'll find it a surprising aid to *faster and better shoveling.*

SINCE 1774

Parkersburg, W. Va.—**Ames Baldwin Wyoming Co.**—North Easton, Mass.

A BW

O. AMES
RED EDGE
PONY
BALDWIN
KNOX-ALL
BRONCO
MONONGAH
HUSKY
PEERLESS
3-STAR
PINNACLE
2-STAR

for 1936

On your dry jobs we wish you success.

On your *wet* ones we guarantee it

With a Wellpoint System that WORKS

Every time and *all* the time

In mud, sand or a mixture of both.

MORETRENCH CORPORATION

Sales Office: 90 West Street, New York City

Works: Rockaway, New Jersey

Alpena County Courthouse, Alpena, Michigan. Wm. H. Kuni, architect. Henry C. Weber Construction Co., Bay City, contractor. M. D. Cooley, state engineer for P. W. A., Emil Schiebel, project engineer.

A MAJOR BUSINESS OPPORTUNITY FOR GENERAL CONTRACTORS

Architectural Concrete —*the method whereby you build walls, floors, columns, ornamental detail and all — monolithically, in* one *operation, with* one *plant and crew*

This method after years of service testing in beautiful buildings from Alaska to the Gulf is rapidly gaining wider acceptance. Throughout the country, during 1935, scores of important commercial and industrial buildings, schools, churches, auditoriums, hospitals, homes and other structures were built by this method—many times more than in any previous year.

Architectural Concrete buildings have a beauty and distinction all their own. Plus low first cost, fire safety, earthquake resistance and long life with low maintenance.

School boards, business executives and others who plan to build in your community this year are awakening to these appealing advantages. Architects are discovering the infinite possibilities for design.

To acquaint buyers of buildings more fully with this type of construction we are immediately launching a national advertising campaign in such publications as "Fortune" and "Business Week."

The contractor whose organization is familiar with the Architectural Concrete technique will be in a fortunate position. Your inquiry is invited. We are prepared to furnish all necessary information.

A NEW WHO'S WHO OF BUILDINGS

Some of the Scores of Notable Architectural Concrete Buildings Completed or Begun Throughout America in 1935

Bronx Terminal Market, New York City
International Printing Ink Co., Industrial Buildings, Lodi, N. J., and Chicago
Swarthmore College Field House, Swarthmore, Pa.
State Penitentiary, Reedsville, Ga.
Federal Court House, Columbia, S. C.
Nemours Carillon Tower, Wilmington, Del.
Negro Girls' School, Mt. Meigs, Ala.
Jones Dabney Co., Industrial Building, Louisville, Ky.
American Malting Co., Industrial Building, Detroit, Mich.
Administration Building, Ft. Peck Dam, Montana
Power House, North Platte, Nebr.
Post Offices, Dalhart, Ludwig and Stephenville, Texas
California Fruit Growers Exchange, Los Angeles
Venice High School, Venice, Calif.
Jefferson High School, Los Angeles

PORTLAND CEMENT ASSOCIATION
Dept. A1-16, 33 W. Grand Ave., Chicago, Ill.

Please send literature checked
☐ "Beauty in Walls of Architectural Concrete"
☐ Information sheets on architectural concrete specifications and other details

Name.....
Address.....
City..... State.....

Built Stronger For Rougher Usage

THE IMPROVED MODEL

of the

"FAVORITE" Reversible Ratchet WRENCH

Is Just The Tool For Contractors

on the nut-turning portion of the contract that must be speeded up

*CADMIUM FINISH

BUILT OF A STRONG, TOUGH METAL

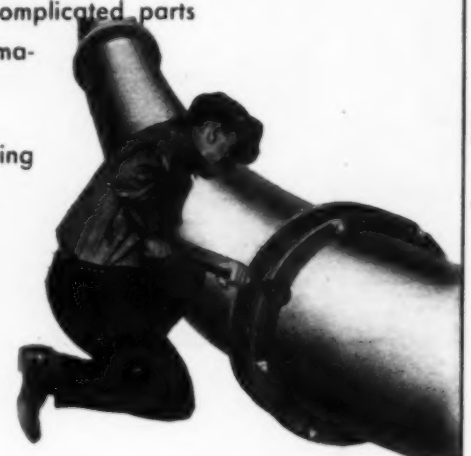
Works on a quick straight-ahead ratchet movement, and the socket form of head is not removed from the nut until operation is completed.

Can be used in narrower places than an ordinary wrench.

A TIME-SAVER

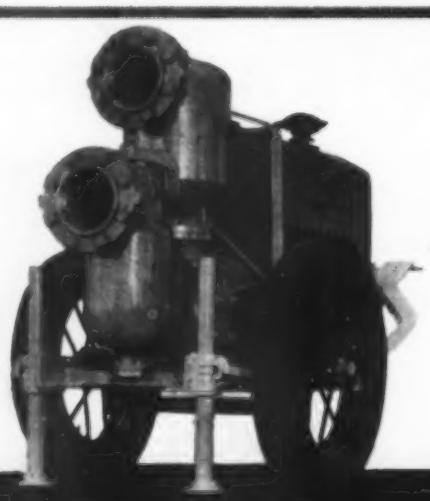
The design of the "Favorite" wrench is simplicity itself, having no complicated parts necessitating expensive machine work.

It is an efficient time-saving tool at a proper price.



Write for full particulars

GREENE, TWEED & CO.,
109 Duane St. New York
Sole Manufacturers



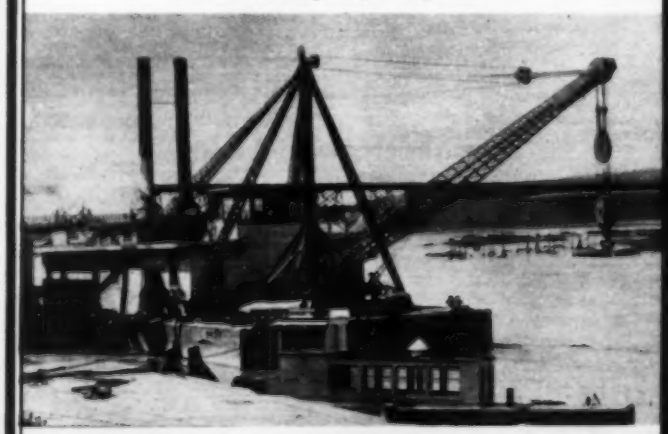
LABOUR PUMPS

Husky strength and maximum simplicity—only one moving part—combine to make LaBour Pumps dependable as the day is long. They're always on the job—which means fewer grey hairs in your head and more dollars in your pocket. Write for complete details.

THE LABOUR COMPANY, INC.
1300 Sterling Avenue
ELKHART IND

CLYDES at FORT PECK

10 Clyde hoists and 2 steel barge derricks, (illustrated below) were specially designed for work at Fort Peck, in addition to the standard Clyde equipment already in use there. Construction projects of this size and importance demand the finest equipment obtainable . . . . the choice of Clydes is justified by their high standards of quality and performance.



CLYDE SALES CO.
DULUTH, MINN.

"Via Barber-Greenes"

B-G 82 Bucket Loader
B-G Bituminous Paver

Check your handling methods—see how many jobs could be done "Via Barber-Greenes". Just another way of seeing if the material could be moved cheaper, faster, easier.

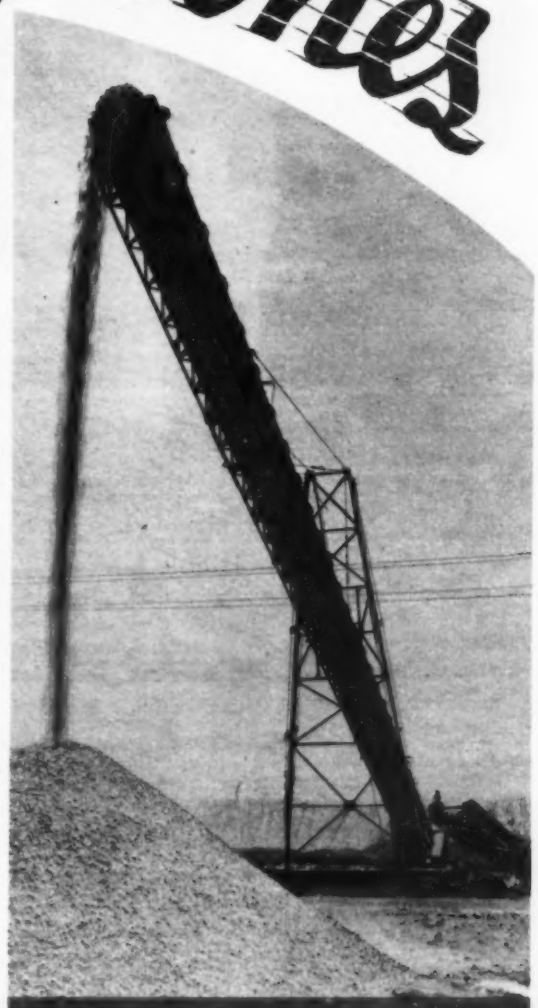
For instance you can't beat the low cost per yard of the B-G Model 82 Bucket Loader for loading your trucks from the pile or bank. Its new slow crowding, synchronized feeding, and many other valuable features make other methods too costly.

Barber-Greene Stackers have established an enviable reputation for combining long reach and high piling with the low cost of belt conveyor operation. There are many choices of chassis to select from, including the B-G crawlers that are not only power propelled—but power swivelling.

The B-G Bituminous Paver still offers the most economical means of laying low cost bituminous paving. It gives accurate proportioning and thorough mixing, while operating continuously. It requires less supervision, involves less weather hazards—has many other advantages.

If you have ditching to do—look at the Barber-Greene Ditcher with its Vertical Boom — Automatic Overload Release — Self Cleaning Buckets—Oscillating Axle, etc. It has milled its way through Florida's coral rock—raced its way across the oil fields. Speed and diggability combined.

If you don't make the Road Show, phone, wire, or write for complete information on any of the long list of Barber-Greene's Standardized Material Handling Machines.



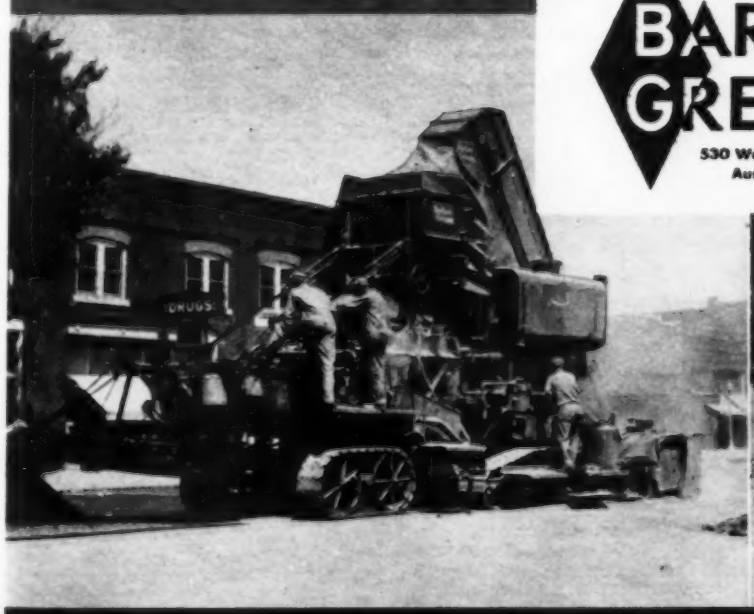
B-G Stacker
B-G Ditcher

Standardized Material Handling Machines

BARBER GREENE

530 West Park Avenue
Aurora, Illinois

36-2



SEE YOU IN CLEVELAND

Barber-Greene Booth G-10 In the Entrance Arcade

G&R PUMPS

"Come up to see us sometime"
While you are at the
ROAD SHOW

Let us show you —

There is only the impeller
inside the G & R PUMP.

- No gadgets
- No orifice to plug
- No control valve to jam

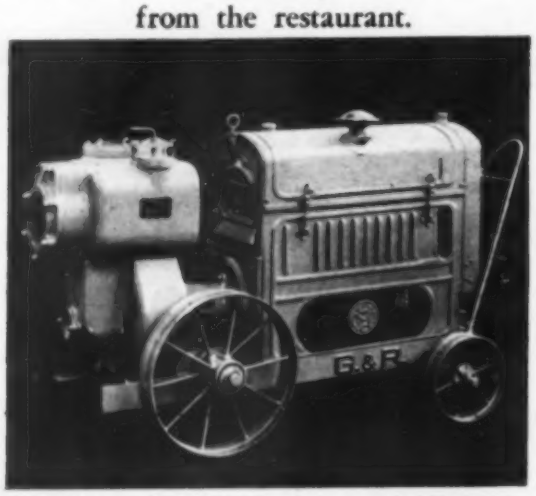
Just nothing to get out of order.

See with your own EYES —

Compare the G & R PUMP with
all others at the Road Show

Make this comparison — then you will understand why G & R is the most dependable contractors drainage pump.

Our BOOTH C7, will be easy to find — across aisle from the restaurant.



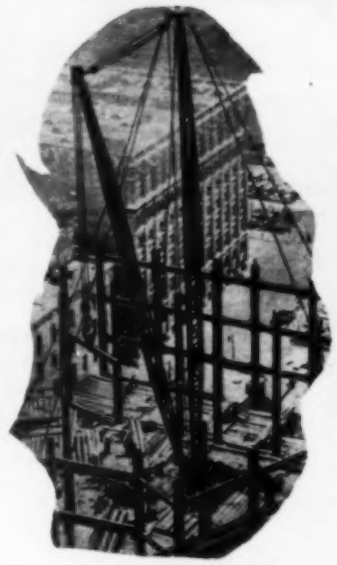
8-inch Pump Model H 18—Capacity 150,000 G.P.H.

SOLD BY 100 DISTRIBUTORS IN PRINCIPAL CITIES

THE GORMAN-RUPP CO.
Mansfield, Ohio

TRADE MARK
DOBBIE
ESTABLISHED 1862

All Steel DERRICKS



Steel Erectors Guy Derrick, with Ball Bearing Footblock.

Guarantee Safety

When you guarantee safety, you economize — for safety means uninterrupted operation and lowest possible maintenance costs.

And DOBBIE All-Steel Derricks have been designed for safety and consequent economy. They have a safe load capacity of almost twice their rating. You need this assurance of dependable safety and continuous performance.

SAVE POWER BY USING BALL OR ROLLER BEARING FOOTBLOCKS AND SHEAVES. Built in both Guy and Stiff-leg types. Write for information and prices.

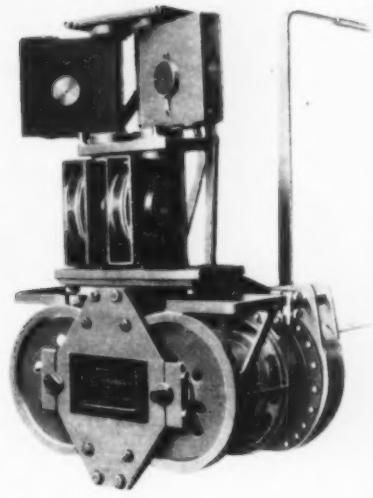
DOBBIE FOUNDRY & MACHINE CO.
Niagara Falls, N. Y.

Other Dobbie Products—Steel Derricks, Timber Derrick Fittings, Hand Winches, Motor Driven Winches, Blocks, Sheaves, etc.

COMPLETE
gives PLENTY OF IT*
An addition to the Sewage Disposal Works at Oklahoma City where COMPLETE WELLPOINT SYSTEMS made excavation possible 17 feet below water level. Soil encountered was fine sand, quicksand, gumbo and gravel.
Write for job estimates and literature.
Complete Machinery and Equipment Co., Inc.
36-36 11th Street Long Island City, N. Y.
*NOTE SIZE OF STREAM ON DISCHARGE

LE TOURNEAU

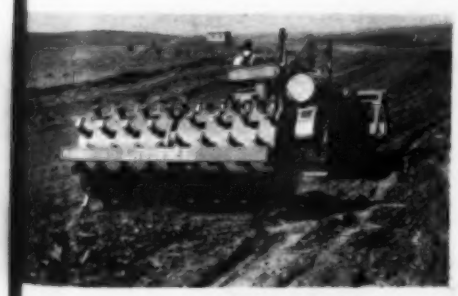
for LOW COST YARDAGES



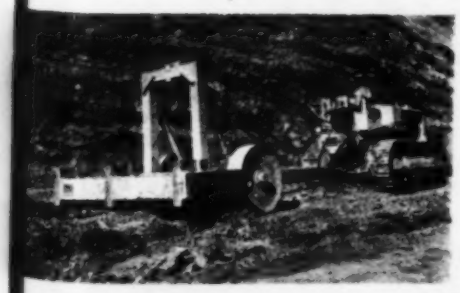
A FASTER, BETTER-OPERATING METHOD

The cable control of the LE TOURNEAU PO ER CONTROL UNIT evolved naturally from search for a faster, cheaper way of handl earth and rock. Its designer, R. G. Le Tourne tried such methods of control as hydraulic, el tric, and other auxiliary motors; discarded th all as too slow, too complicated, too limited action and power delivery; adopted mechan cable control only after extensive job-use pro it definitely a faster, better-operating meth Its speed makes for greater output; its simp ity, for long life and low maintenance cost. action, trigger-quick, positive, and accurate— LE TOURNEAU POWER CONTROL UI is today the fastest, most efficient method on market for operating heavy construction eq ment. Weather does not affect it.

BULLDOZER



SHEEP'S FOOT ROLLER



ROOTER

For profitable earthmoving, LE TOURNEAU offers a complete line of fast-operating, big-capacity equipment.

CARRYALL SCRAPERS in 6, 8 and 12-yard sizes to operate with 40 to 95 HP tractors, for cut and fill work, excavating, grading, finishing, land-levelling and dam building.

BULLDOZERS and ANGLEDOZERS with correctly-curved bowl, built to dig, making down pressure unnecessary; with fast, high, powerful lift and low drop; of light, yet stout and rigid construction; made for all size tractors, from 30 HP up. ANGLEDOZERS with simple angling adjustment — rigid in all positions.

ROOTERS to break up the toughest of materials. Two sizes — Type "S" with 20″ maximum penetration, and Heavy-Duty with 28″. Both sizes will stand the full pull of the largest tractors.

SHEEP'S FOOT ROLLERS built to meet exacting Government and State specifications, for compacting highways, reservoirs, dams and embankments.

CRANES in three boom lengths — 20, 30, and 40-foot — for use with tractors from 20 to 90 HP. The "handy man" on the job or in the yard.

Write us describing your construction problems. Our Engineering Department will gladly consult with you and tell you how other earthmovers are overcoming similar problems by using LE TOURNEAU equipment.

R. G. LE TOURNEAU, INC.

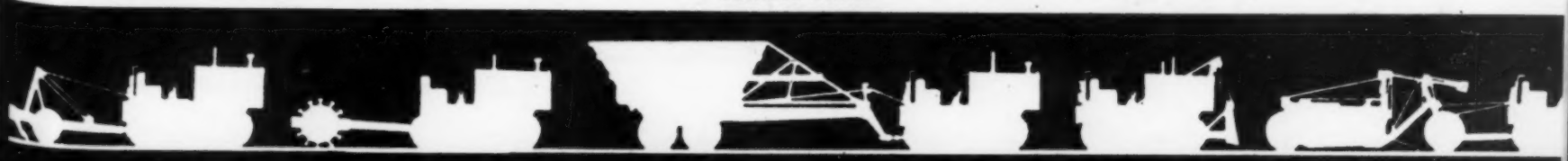
PEORIA, ILLINOIS **STOCKTON, CALIFORNIA**

Cable Address: "Bobletorno"

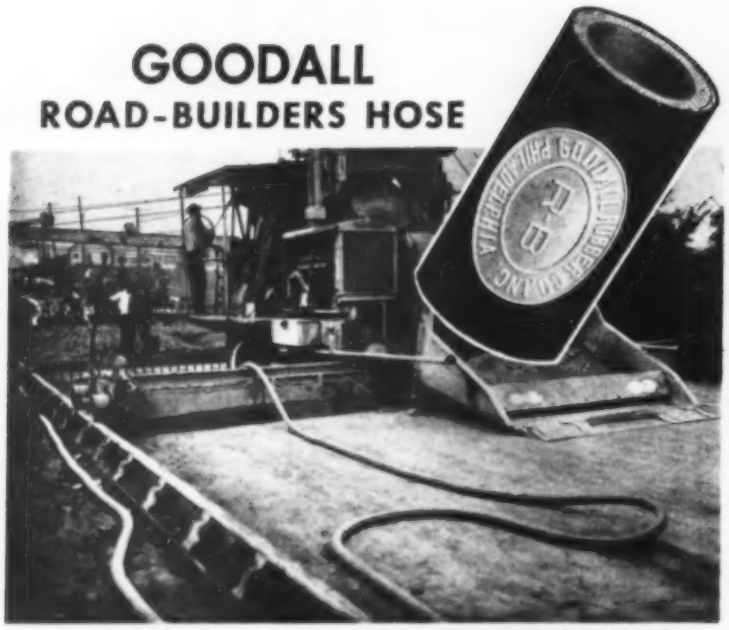
Manufacturers of: ANGLEDOZERS, BULLDOZERS, BUGGIES, CARRY-ALL SCRAPERS, CRANES, ROOTERS, SHEEP'S FOOT ROLLERS, POWER CONTROL UNITS.

ANGLEDOZER

CRANE



GOODALL
ROAD-BUILDERS HOSE



Goodall "Road-Builders" Hose is the natural choice of road contractors. Only the best of materials are used, thus assuring complete satisfaction. The fact that it keeps mixers and pavers in steady operation and more than earns the initial cost through long, steady, dependable service is proven by the many repeat orders from contractors thousands of miles away in order that they have genuine "Road-Builders" Hose on the job.

GOODALL SUBWAY BRAND
Air-Drill and Compressor Hose

The ever increasing use of air tools for all types of construction work has resulted in the development of "Subway" Hose for use on Air Spades, Concrete Breakers, Rock Drills, Compressors—in fact, for all contractors' air equipment—where dependable service and ultimate low cost is required. "Subway" will free you from your air hose problems.

THERE IS A GOODALL HOSE FOR EVERY PURPOSE — USE IT ON YOUR NEXT JOB

GOODALL RUBBER COMPANY
PHILADELPHIA, PA.

New York • Pittsburgh • Chicago • Cleveland • Houston

Mills at Trenton, N. J.

Distributors in the principal cities

WEST COAST DISTRIBUTOR
Mechanical Products Corp.
510-514 East Fourth St.
Los Angeles, Calif.

MICHIGAN DISTRIBUTOR
Michigan Mechanical Rubber Co.
8642-26 Gratiot Avenue
Detroit, Mich.

Branches: San Francisco • Seattle • Portland

GOODALL The originators of the "Standard of Quality" Line (Reg. U. S. Pat. off.) of contractors rubber goods.

TRADE Good Roads MACHINERY MARK

See the CHAMPION at Booth E-4

ROLLER-BEARING ROCK CRUSHERS

Completely Portable

CRUSHING — SIZING — LOADING
PLANTS — FOR STONE OR GRAVEL

CRUSHING SCREENING FEEDING ELEVATING
CONVEYING AND WASHING EQUIPMENT

Portable and Stationary plants engineered and built to give desired production requirements

Products of

GOOD ROADS MACHINERY CORP.

"Builders of Rock Crushers for 45 years"

KENNETT SQUARE PENNSYLVANIA

Section of Pennsylvania Railroad Tunnel Under the East River, New York City, being waterproofed with—

Sika

Use Sika to stop the inflow of water through dams, walls of pump houses, man-holes, filter beds, sewage tunnels, etc. Sika mixed with portland cement is easily applied by hand and will successfully seal off infiltration from underground streams even under pressure.

Write us about your problems.

Sika, Inc.

1943 Grand Central Terminal, New York City

SHOWN FOR THE FIRST TIME

At the Road Show

NOVO TYPE V

VALUE VOLUME

SELF PRIMING CENTRIFUGAL PUMPS

Here's Value—and—Volume.

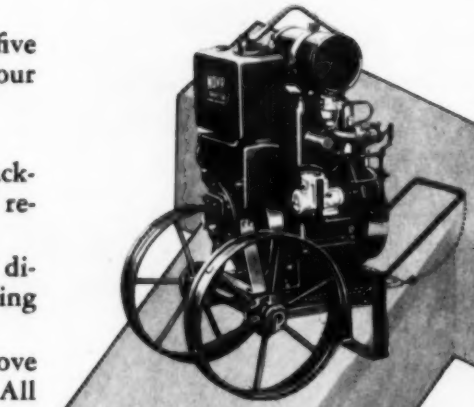
The V line of pumps are built in five sizes, 10.- to 36,000 gallons per hour capacity.

Simple and *compact* in design.

Lubricated leather seals eliminate packing. The seals sustain fast priming and require no attention.

"Slideaway" handles further reduce dimensions and are out of the way during operations.

All power units are water cooled. Above 3-H.P. radiator cooled with house. All pumps have a suction strainer and a hoisting sling.



2"
3-H.P.
10,000 G.P.H.
$137.50

4"
9-H.P. 30,000 G.P.H.
$300.00

3"
5-H.P.
18,000 G.P.H.
$210.00

3"
7-H.P. 24,000 G.P.H.
$270.00

Booth No. F-18 at the Road Show, Cleveland, O., Jan. 20-24. Stop in at our booth and look over this new line of pumps. There will also be a brand new 4-cylinder engine and a single-cylinder, air-cooled engine on display.

4"
15-H.P. 36,000 G.P.H.
$395.00

Send this Coupon:

Novo Engine Company, 214 Porter Street, Lansing, Mich.

Send me complete information on the new Model V Self-Primers .....
Also the larger sizes of heavy duty pumps .....

Name .....

Address .....

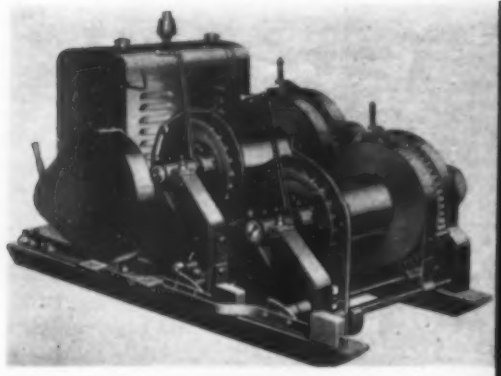
City ..... State .....

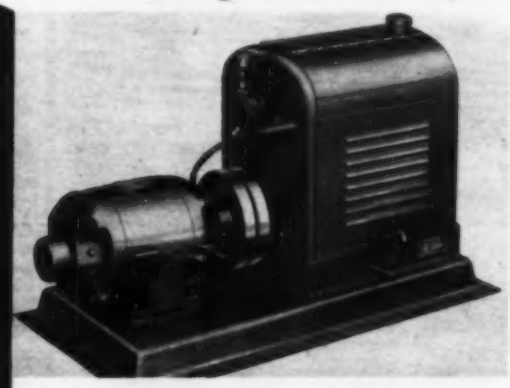
PUMPS HOISTS ENGINES
NOVO ENGINE COMPANY
LIGHT PLANTS STARTING UNITS

SEE US AT THE ROAD SHOW

Cleveland, Jan. 18-24

Sterling Booth C-20





See the 8-Inch SELF-PRIMING Oil Engine Pump

As a special feature of the show, Sterling will have on display an 8-inch, self-priming pump equipped with oil engine. This pump will prove of interest to every contractor or engineer who is desirous of securing the greatest efficiency and economy from his pumping units. Jot down the location now — BOOTH C-20. You will be well repaid for your visit.

Be Sure to Visit the
STERLING BOOTH AT THE ROAD SHOW

There's a real treat in store for you at the big road show in Cleveland. Be sure to visit the Sterling Booth, C-20 and learn why the largest contracting firms specify Sterling Quality Pumps, Hoists, Saw Rigs and Lighting Plants.

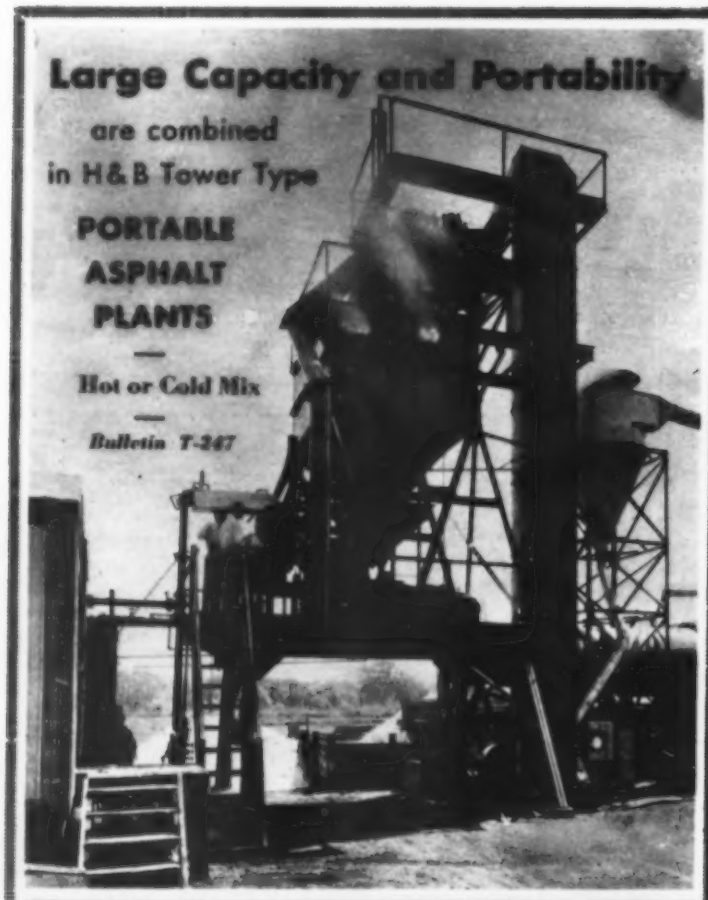
If you do not attend the Show — then write for catalogs and literature on these famous units.

Sterling
MACHINERY CORPORATION
411-13 Southwest Blvd. Kansas City, Mo.

A DISPLAY Both Interesting and Instructive

To celebrate the return of the road show we have planned a most interesting and instructive exhibit. We will take you behind the scenes and tell you why Sterling Units have been able to stand up year after year under the most exacting conditions. We will show you why the largest contracting organizations prefer STERLING.

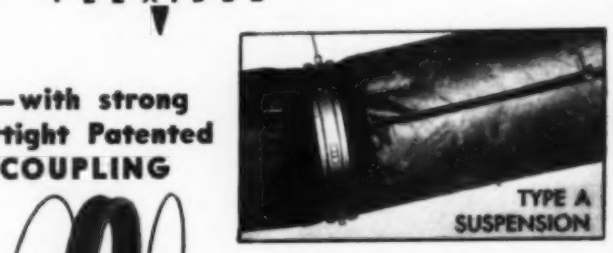
Large Capacity and Portability
are combined
in H&B Tower Type
PORTABLE ASPHALT PLANTS
—
Hot or Cold Mix
—
Bulletin T-247



HETHERINGTON & BERNER, Inc.
INDIANAPOLIS, INDIANA
Builders of Asphalt Paving Machinery for over Fifty years

MineVent TRADE MARK FLEXIBLE **BLOWER PIPE**

—with strong Airtight Patented COUPLING



—made in a jiffy
—eliminates twisting

Rust proof. Indestructible. Quickly mounted, demounted. Eliminates sewing. Uses up odd lengths. Tubing can be rotated in coupling. Wear and tear and slack taken up by pulling tubing through rings. Coupling always airtight.

OTHER FEATURES

Mine-Vent supplied in any length desired without sewing. Fabric *specially treated* to reduce air friction and resist corrosive conditions. Unique TWO-SEAM SUSPENSION provides positive support and materially reduces installation and upkeep costs. To reduce your air line costs — investigate MINE-VENT now!

AMERICAN BRATTICE CLOTH CO.
WARSAW, INDIANA, U. S. A.
Distributors in Principal Cities

Don't miss the new Continental
TRACTOR EQUIPMENT
Spaces B-8 and B-9
at the Road Show!

THE NEW CONTINENTAL 7 YARD WAGON SCRAPER
it digs—it scoops—it loads—it hauls—it dumps!

It moves more dirt *faster!*

The *new* 7 yard Continental Wagon Scraper is the last word in *fast, economical* dirt moving equipment! It is simple, fool-proof, extremely flexible in operation and ruggedly built to withstand a lot of heavy going.

Continental Wagon Scrapers *Scoop — Dig — Load* and *Haul.* They can be used to dump over banks or in windrows, for backfilling or stock piling.

No extra labor is needed with Continental Wagon Scrapers. The tractor operator does the work with hydraulically actuated controls conveniently located on the tractor. Operation is quick and maximum manueverability so essential in close fills on bridges, culverts or walls is fully developed.

Continental Wagon Scrapers are now made in 5 and 7 yard sizes for use with Allis-Chalmers, Caterpillar, Cletrac and McCormick-Deering tractors. A new 9 yard unit will be available soon.

See the 7 yard Scraper in operation at the Road Show, Spaces B-8 and B-9. Get first hand information on the low cost, flexible operation of this *faster* dirt moving equipment.

Continental RollClear Rippers, a *new* side mounted Bull-dozer and a Trailbuilder will also be displayed. See these equipments when you're there — if you miss them at the Show write for descriptive bulletins.

SUPERIOR ROAD MAKING MACHINERY

TRACTOR EQUIPMENT DIVISION
CONTINENTAL ROLL & STEEL FOUNDRY CO.
332 S. Michigan Ave., Chicago, Ill.

EQUIPMENT and MATERIALS

An index of products made by manufacturers whose advertisements appear in this issue of Construction Methods.

If you do not find all you need in the advertising section, we shall be glad to assist you. Write to—

CONSTRUCTION METHODS
Information Bureau
330 West 42nd St. New York City

ASPHALT
Texas Company

ASPHALT PLANTS
Blaw-Knox Company
Hetherington & Berner, Inc.

BACK FILLERS
Austin Western Road Mchry. Co.
Harnischfeger Corp.
Northwest Engineering Co.

BARS, IRON AND STEEL
Inland Steel Co.

BATCHERS, ADJUSTABLE MEASURING
Blaw-Knox Company

BATTERIES, STORAGE
Firestone Tire & Rubber Co.

BELTING
Firestone Tire & Rubber Co.
Goodall Rubber Co.

BINS, STORAGE
Blaw-Knox Company
Chain Belt Company
Jeffrey Manufacturing Co.

BLASTING ACCESSORIES
Atlas Powder Co.
Ensign-Bickford Co.

BOLTS, NAILS, NUTS, RIVETS and SPIKES
Inland Steel Co.

BOOKS, ENGINEERING and TECHNICAL
McGraw-Hill Book Co.

BOOTS, RUBBER
Goodall Rubber Co.

BUCKETS
Blaw-Knox Company
Bucyrus-Erie Co.
Harnischfeger Corp.
Insley Mfg. Company
Jeffrey Manufacturing Co.
Link-Belt Co.
Northwest Engineering Co.

BUILDINGS, STEEL
Blaw-Knox Company

BULLDOZERS
Baker Mfg. Co.
Continental Roll & Steel Fdry. Co.
Le Tourneau, Inc., R. G.
Roebling Son's Co., J. A.

CABLEWAYS
Roebling Son's Co., J. A.

CABLE, ELECTRIC
Roebling Son's Co., J. A.

CARTS, CONCRETE
Ransome Concrete Mchry. Co.

CEMENT
International Cement Corp.
Portland Cement Assoc.
Universal Atlas Cement Co.

CEMENT (BULK) HANDLING EQUIP.
Barber-Greene Co.
Blaw-Knox Company

CHUTES, CONCRETE
Insley Manufacturing Co.

COMPRESSORS, AIR
Allis-Chalmers Mfg. Co.
Novo Engine Co.
Schramm, Inc.

CONCRETE REINFORCEMENT
Inland Steel Co.
Wickwire Spencer Steel Co.

CONCRETE SLAB RAISING EQUIPMENT
Koehring Company

CONVEYING & STORAGE SYSTEMS
Barber-Greene Co.
Chain Belt Company
Jeffrey Manufacturing Co.
Link Belt Co.

CONVEYORS, BELT, BUCKET & CHAIN
Barber-Greene Co.
Chain Belt Company
Jeffrey Manufacturing Co.
Link Belt Co.
Wickwire Spencer Steel Co.

CRANES, GAS, ELECTRIC, DIESEL & STEAM
American Hoist & Derrick Co.
Austin Western Road Mchry. Co.
Bay City Shovels, Inc.
Bucyrus-Erie Co.
Clyde Sales Co.
Harnischfeger Corp.
Koehring Company
Link Belt Co.
Michigan Power Shovel Co.
Northwest Engr. Co.
Osgood Company
Ransome Concrete Mchry. Co.
Thew Shovel Co.
Universal Crane Co.

CRANES, MOTOR TRUCK
Thew Shovel Co.
Universal Crane Co.

CRUSHERS & PULVERIZERS
Acme Road Mchry. Co.
Allis-Chalmers Mfg. Co.
Austin Western Road Mchry. Co.
Galion Iron Works & Mfg. Co.
Good Roads Mchry. Co.
Jeffrey Manufacturing Co.

CULVERTS
Armco Culvert Mfrs. Assn.
Austin Western Road Mchry. Co.

DERRICKS & DERRICK FITTINGS
American Hoist & Derrick Co.
Clyde Sales Co.
Dobbie Fdry. & Machine Co.
Harnischfeger Corp.

DRAGLINES
(See Cranes & Shovels)

DRAWING PAPER
Wade Instrument Co.

DREDGES
Bucyrus-Erie Co.
Harnischfeger Corp.
Link Belt Co.

DRILLS
Schramm, Inc.

DRILLS, WAGON
Bucyrus-Erie Co.

DUMP BODIES, TRUCK
Athey Truss Wheel Co.

DYNAMITE
Atlas Powder Co.

ELEVATORS, BUCKET
Chain Belt Company
Jeffrey Manufacturing Co.
Link Belt Co.

ELEVATORS, CONTR. MATERIAL
Barber-Greene Co.
Chain Belt Company
Galion Iron Works & Mfg. Co.

ENGINES, PORTABLE
Allis-Chalmers Mfg. Co.

ENGINES, STATIONARY, DIESEL & GAS
Caterpillar Tractor Co.
Novo Engine Co.

EXCAVATORS, DITCH & TRENCH
American Hoist & Derrick Co.
Baker Mfg. Co.
Barber-Greene Co.
Bay City Shovels, Inc.
Bucyrus-Erie Co.
Harnischfeger Corp.
Koehring Company.
Link Belt Co.
Northwest Engr. Co.
Osgood Company
Thew Shovel Co.
Universal Crane Co.

EXCAVATORS, DRAGLINE
Austin Western Road Mchry. Co.
Bay City Shovels, Inc.
Bucyrus-Erie Co.
Harnischfeger Corp.
Insley Mfg. Company
Koehring Company
Link Belt Co.
Northwest Engr. Co.
Novo Engine Co.
Thew Shovel Co.
Universal Crane Co.

EXPLOSIVES
Atlas Powder Co.

FLOORING
Barrett Company
Texas Company

FLOOR PLATES, STEEL
Inland Steel Co.

FORMS, CONCRETE
Blaw-Knox Company

FUSE, BLASTING
Atlas Powder Co.
Ensign-Bickford Co.

GENERATORS, ELECTRIC
Electric Tamper & Equip. Co.

GRADERS, ROAD
Acme Road Mchry. Co.
Allis-Chalmers Mfg. Co.
Austin Western Road Mchry. Co.
Blaw-Knox Company
Caterpillar Tractor Co.
Galion Iron Works & Mfg. Co.
Good Roads Mchry. Co.

GRAVEL WASHING PLANTS
Austin Western Road Mchry. Co.
Galion Iron Works & Mfg. Co.
Iowa Mfg. Co.

GUARD RAILS, HIGHWAY
Hazard Wire Rope Co.
Wickwire Spencer Steel Co.

HOISTS, GAS, ELECTRIC, DIESEL & STEAM
Allis-Chalmers Mfg. Co.
American Hoist & Derrick Co.
Clyde Sales Co.
Dobbie Fdry. & Machine Co.
Harnischfeger Corp.
Novo Engine Co.
Sterling Machinery Corp.

HOISTS, HAND
Chain Belt Company
Sterling Machinery Corp.

HOSE, AIR, WATER & STEAM
Goodall Rubber Co.

JOINTS, PAVING
Barrett Company
Flexible Road Joint Machine Co.
Texas Company
Truscon Steel Co.

LATH, EXPANDED METAL
Wickwire Spencer Steel Co.

LIGHTING PLANTS
Novo Engine Co.
Sterling Machinery Corp.

LINER PLATES, STEEL
Blaw-Knox Company

LOADERS, PORTABLE
Barber-Greene Co.
Jeffrey Manufacturing Co.
Link Belt Co.

LUBRICANTS
Alemite Div. Stewart Warner Co.
Gulf Refining Co.
Roebling Son's Co., J. A.
Texas Company

LUBRICATING SYSTEMS
Alemite Div. Stewart Warner Co.

MAINTAINERS, ROAD
Allis-Chalmers Mfg. Co.
Austin Western Road Mchry. Co.
Galion Iron Works & Mfg. Co.

MIXERS, CONCRETE & MORTAR
Chain Belt Company
Jaeger Machine Co.
Koehring Company

MIXERS, PAVING
Chain Belt Company
Koehring Company

MIXERS, TRUCK
Blaw-Knox Company
Chain Belt Company
Jaeger Machine Co.

MIXING PLANTS, CENTRAL
Blaw-Knox Company
Chain Belt Company
Jaeger Machine Co.

PAINTS
Barrett Company

PAINTS, WATERPROOFING
Sika, Inc.

PAVEMENT BREAKERS
Schramm, Inc.

PAVING, COLD PATCHING
Texas Company

PAVING, HAND TOOLS
L & M Mfg. Co.

PILE DRIVERS
American Hoist & Derrick Co.
Harnischfeger Corp.

(Continued on page 96)

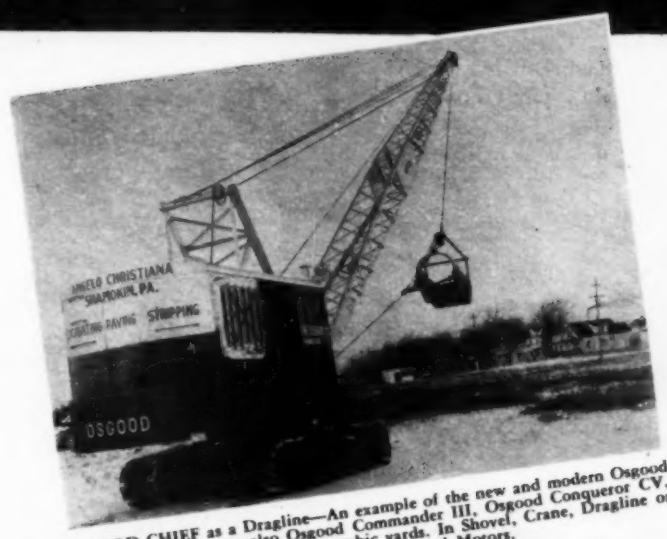
Always FIRST *Always* MODERN

First in 1872 . . . and First ever since!
Always the Leader . . . as well as the Pioneer!

OSGOOD

Now, as always—leads in NEW, MODERN, and BRILLIANT Features in Design,

Materials and Construction of every product of its own manufacture and of Its wholly owned Subsidiaries and Associated Companies.

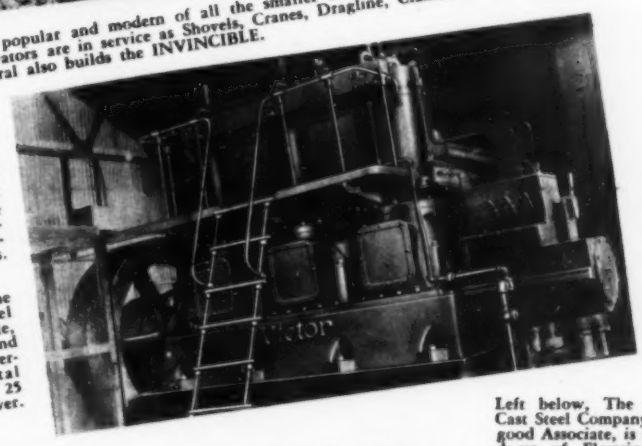


The OSGOOD CHIEF as a Dragline—An example of the new and modern Osgood digging machine. There are also Osgood Commander III, Osgood Conqueror CV, Osgood Victor MV. Capacities up to 2 cubic yards. In Shovel, Crane, Dragline or Clamshell. Powered with Gasoline, Electric or Diesel Motors.

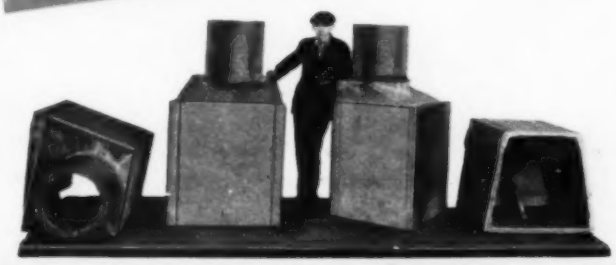
Most popular and modern of all the smaller Excavators. Close to 800 General Excavators are in service as Shovels, Cranes, Dragline, Clamshells and Backhoes. General also builds the INVINCIBLE.

Left, The HERCULES Roller with the greatest Road Rolling discovery of all time — The HERCULES "Ironer Roll"— it makes a fair road the "Perfect Highway." Hercules is built in 6-8-10-12-14 and 15 ton sizes.

Right, The Pioneer Prime Mover of the Diesel Engine Field. Simple, efficient, economical and powerful. Built in Vertical and Horizontal Types. In sizes from 25 horse to 200 horse power.



Left below, The Alloy Cast Steel Company, Osgood Associate, is a producer of Electric Steel Castings in regular carbons and alloys. It manufactures castings for many Road Machinery Builders including Osgood and the General Excavator Company.



Left, The Commercial Steel Castings Company, Osgood subsidiary, is a large producer of Steel and Iron Castings. This modern Foundry makes castings for the leading Industrials and for the Osgood, Hercules and General Excavator Companies.

THE OSGOOD CO. . . . THE HERCULES CO. . . . THE GENERAL EXCAVATOR CO.
THE POWER MANUFACTURING CO. . . . THE COMMERCIAL STEEL CASTINGS CO.
THE ALLOY CAST STEEL CO.

MARION, OHIO, U. S. A.

See The OSGOOD-HERCULES-GENERAL EXHIBIT, SPACE B-25 ROAD SHOW
CLEVELAND, OHIO—JANUARY 18-24 Inclusive

PILING, INTERLOCKING STEEL
Inland Steel Co.

PIPE DRAIN
Armco Culvert Mfrs. Assn.

PIPE INSTALLATION METHODS
Armco Culvert Mfrs. Assn.
Hydranger Corp.

POWDER
Atlas Powder Co.

PUMPS, PORTABLE
Chain Belt Company
Gorman-Rupp Co.
Jaeger Machine Co.
La Bour Company
Moretrench Corp.
Novo Engine Co.
Sterling Machinery Corp.

PUMPS, STATIONARY
Allis-Chalmers Mfg. Co.
Chain Belt Company
La Bour Company
Novo Engine Co.
Sterling Machinery Corp.

ROAD OIL & PRESERVATIVES
Barrett Company
Texas Company

ROAD FINISHERS, CONCRETE
Blaw-Knox Company
Flexible Road Joint Machine Co.

ROAD MACHINERY
Austin Western Road Mchry. Co.

ROAD SURFACING HARROWS
Insley Manufacturing Co.

ROLLERS, ROAD
Austin Western Road Mchry. Co.
Galion Iron Works & Mfg. Co.

ROOFING
Barrett Company
Texas Company

ROPE, WIRE
American Steel & Wire Co.
Hazard Wire Rope Co.
Roebling Son's Co., J. A.
Wickwire Spencer Steel Co.

SAW RIGS, PORTABLE
Chain Belt Company
Sterling Machinery Corp.

SAWS, PORTABLE
Vulcan Iron Wks. Co.

SCRAPERS, SCARIFIERS & PLOWS
Austin Western Road Mchry. Co.
Baker Mfg. Co.
Continental Roll & Steel Fdry. Co.
Euclid Road Mchry. Co.
Galion Iron Works & Mfg. Co.
Harnischfeger Corp.

SCREENS, SAND, GRAVEL & COAL
Acme Road Mchry. Co.
Iowa Mfg. Co.
Link Belt Co.
Wickwire Spencer Steel Co.

SHOVELS, HAND
Ames Baldwin Wyoming Co.

SHOVELS, POWER
American Hoist & Derrick Co.
Austin Western Road Mchry. Co.
Bay City Shovels, Inc.
Bucyrus-Erie Co.
Harnischfeger Corp.
Insley Manufacturing Co.
Koehring Company.
Link Belt Co.
Michigan Power Shovel Co.
Northwest Engr. Co.
Osgood Company
Thew Shovel Co.
Universal Crane Co.

SNOW PLOWS & LOADERS
Austin Western Road Mchry. Co.
Baker Mfg. Co.
Galion Iron Works & Mfg. Co.
Good Roads Mchry. Co.

SPREADERS, BITUMINOUS SURFACE
Barber-Greene Co.
Jaeger Machine Co.

SPREADERS, SAND, GRAVEL & STONE
Galion Iron Works & Mfg. Co.

TAR
Barrett Company

TARPAULINS
Dobbie Fdry. & Machine Co.

TIRES, TRUCK
Firestone Tire & Rubber Co.

TOOLS, PNEUMATIC
Schramm, Inc.

TRACTORS, DIESEL & GAS
Allis-Chalmers Mfg. Co.
Austin Western Road Mchry. Co.
Caterpillar Tractor Co.
Cleveland Tractor Co.

TRAILERS, DUMP & CRAWLER WHEEL
Allis-Chalmers Mfg. Co.
Athey Truss Wheel Co.
Austin-Western Road Mchy. Co.
Euclid Road Mchy. Co.
LeTourneau, Inc., R. G.

TRUCKS, MOTOR
Euclid Road Mchy. Co.
Hug Company, The

VENTILATING TUBES
American Brattice Cloth Co.

WAGONS, DUMP & CRAWLER WHEEL
Allis-Chalmers Mfg. Co.
Athey Truss Wheel Co.
Euclid Road Mchy. Co.
Koehring Company
LeTourneau, Inc., R. G.

WAGONS & TRAILERS, DUMP
Austin Western Road Mchry. Co.

WATERPROOFING
Barrett Company
Sika, Inc.
Texas Company

WELDING & CUTTING APPARS.
Harnischfeger Corp.
Hobart Brothers Co.

WELDING RODS & WIRE
Roebling Son's Co., J. A.
Wickwire Spencer Steel Co.

WELLPOINT SYSTEMS
Complete Mchry. & Equip. Co., Inc.
Moretrench Corp.

WHEELS, TRACKLAYING TYPE
Athey Truss Wheel Co.

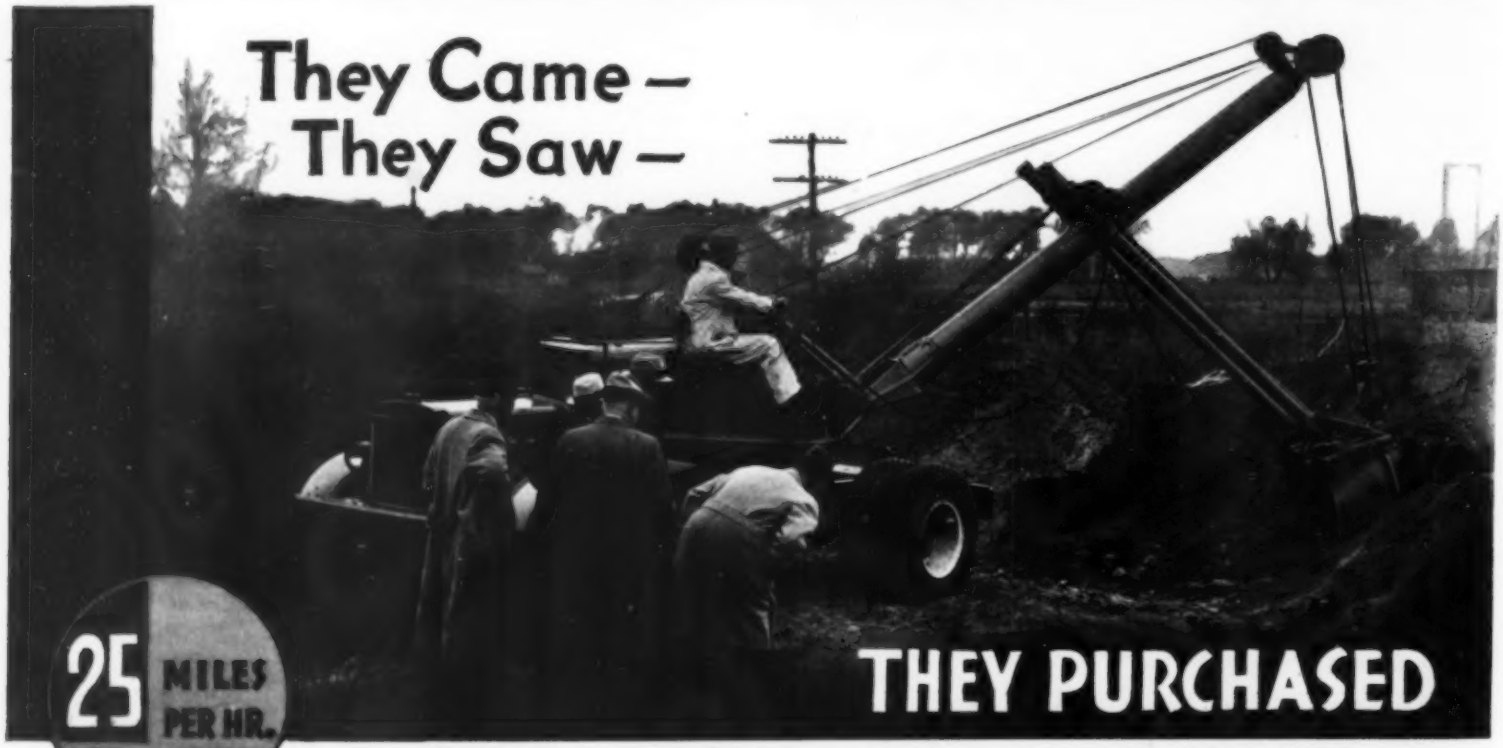
WINCHES
Dobbie Fdry. & Machine Co.

WIRE ROPE ACCESSORIES
Roebling Son's Co., J. A.

WOOD PRESERVATIVES
Barrett Company

WRENCHES
Greene-Tweed & Co.

For page reference see advertisers index, page 98

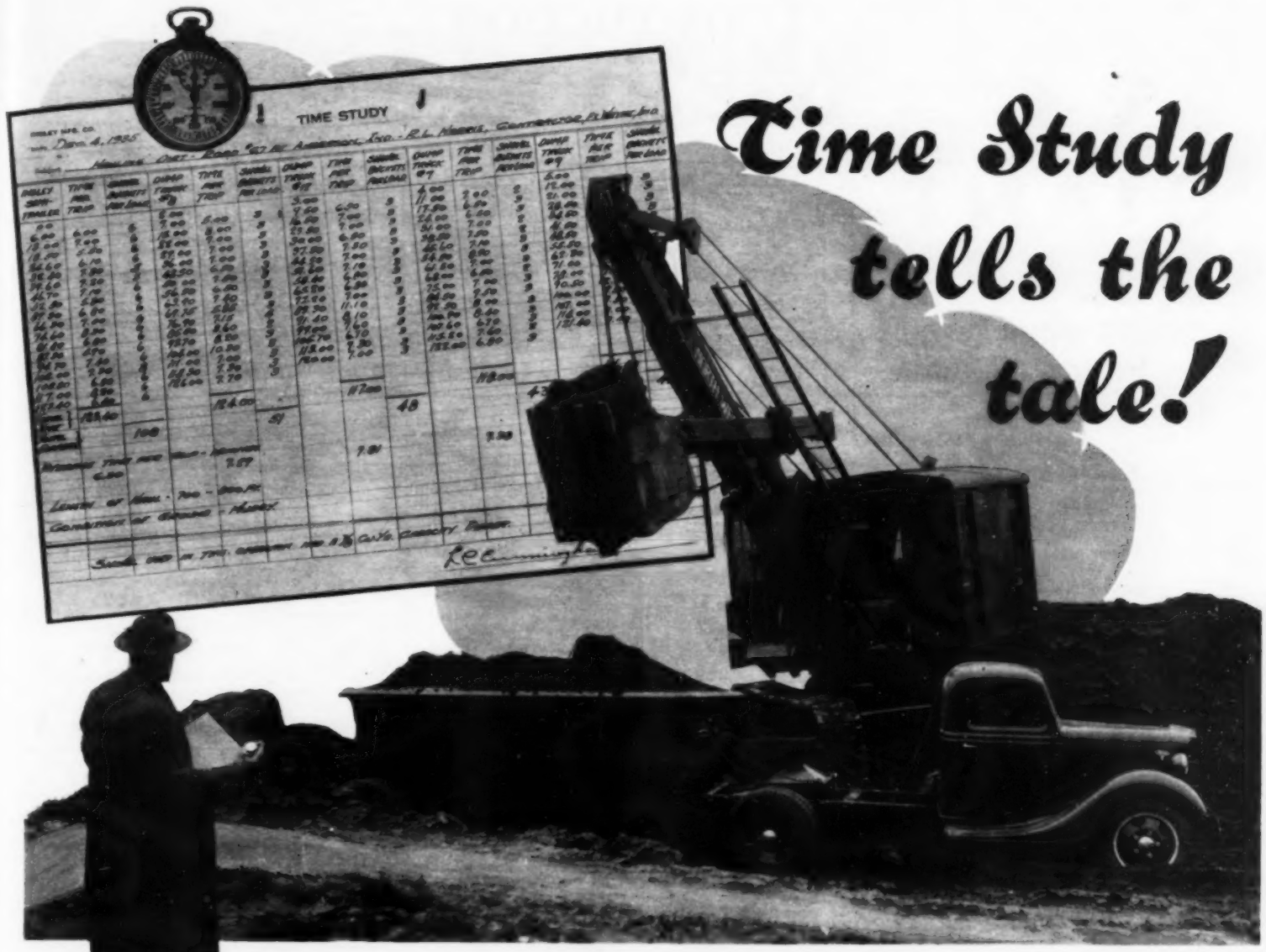


The Michigan Power Shovel and Crane can be seen at the Road Show, Exhibit D-4.

The gentlemen needed a power shovel. They came to Michigan for a demonstration. The Michigan Power Shovel and Crane displayed its surprising speed—flexibility and economy. These features, together with its rugged construction were convincing . . . They purchased; their judgement back by years of buying experience and guided by the performance and reputation of the product.

From New York to California—National, state and county officials—contractors and engineers are buying the MICHIGAN to replace or augment present equipment. For the MICHIGAN can leave one job and be earning money on another in less time than it takes to begin the movement of heavier, more costly types. And, it can be quickly converted to crane, dragline, clamshell, trench-hoe, backfiller or skimmer . . . For full data, write:

MICHIGAN POWER SHOVEL CO., BENTON HARBOR, MICHIGAN



INSLEY SEMI TRAILER DUMPWAGON

Specifications
Semi-Trailer Dirt-Wagon

Item No. 74

Capacity: 5 Cubic Yard, working capacity.

Weight: 5200 lbs.

Length of top: 132" inside.

Width of top: 74" inside.

Height of top: 67" above ground.

Tires: 32"x 6" heavy duty, 8 ply, dual.

The wagon is attached to the truck by locking down the ball and socket bolster to the truck frame.

Distance center of bolster to rear axle — 197".

The doors are closed by action of a clutch with power from the rear axle of the wagon, controlled by a line to the driver's seat. The doors are tripped by a similar line.

Do it faster with an INSLEY

❶ moved over TWICE as much dirt as any other dump truck on the job.

❷ more dirt than any TWO other trucks.

❸ took LESS average time per trip.

TIME — FAST! Place — a road construction job at Anderson, Indiana. Contractor — Ray L. Harris. Study the time chart for yourself — just as if YOU were paying the price. Note the INSLEY SEMI TRAILER averaged 6.30 minutes per trip carried 6-6-5-8-6 shovel buckets each (⅞ cu.yd.) per load! That's proof positive of SPEED AND CAPACITY, isn't it? This is the outfit you want — this 5 cu.yd. wagon — on any road job in which you want real speed and profits. For this Insley cannot only make time but can stand the gaff of hard service. Here's the greatest time saving dirt-mover in the road building field — PROVED so by the facts of actual time study . . . and remember, its an INSLEY.

INSLEY MANUFACTURING CORP. . . . INDIANAPOLIS
Engineers and Manufacturers - - -

Construction Methods Service Section

GIANT-GRIPT

CONCRETE FINISHING TOOLS

Straight Edges—Aluminum or Steel for checking as well as scraping excess water off slab prior to final finishing.
Edgers—Stamped or Cast Iron strong hand grip with curved edges to prevent digging in.
Hand Floats—Standard or Special cut from knot-free cypress. Adjustable stiffner—steel handle bracket permits use with standard G-G handle.
Bull Floats—Scientifically designed-oil treated to prevent concrete stickage. Available in all state-required sizes. Fitted with steel-braced oak plow-handles.
Concrete Brooms—Float Bridges—Tampers—Digging Bars

L&M MANUFACTURING CO.
10301 BEREA RD., CLEVELAND, OHIO

HEAVY DUTY TRAILERS
5 to 100 Tons Capacity

Rogers Heavy Duty Trailers — standard 5 to 50 tons capacity — special up to 100 tons — 4, 6, 8 and 12 wheel type. Gooseneck front permits short turn. Easily loaded — stand the gaff. *Write.*

ROGERS BROS. CORP. ..... ALBION, PA.

Shuredry & Fultex
TARPAULINS
FOR EVERY CONSTRUCTION NEED
Tents, Windbreaks, Burlap for road work — in bale-Waterproofed duck, Cotton Duck in rolls, Drop Cloths. Write today for Catalog, samples and price list.

Fulton Bag & Cotton Mills
Manufacturers Since 1870
ATLANTA ST. LOUIS DALLAS
MINNEAPOLIS BROOKLYN NEW ORLEANS KANSAS CITY, KAN.

CUT REPAIR COSTS IN HALF
You can do it with this New "Simplified" ARC WELDING

30 DAYS
Trial On Your Work—at our risk. Send this ad with your letterhead for a copy of the valuable new manual—it's FREE.
RENT a New Hobart Welder—Savings will pay for it.

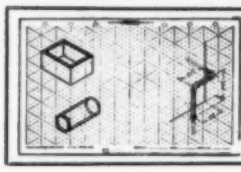
HOBART BROTHERS Box CM-16 Troy, Ohio

DOLMAR

ONE MAN SAW
PORTABLE SAWS
ELECTRIC and GASOLINE
Fast Cutting — Light Weight — Reliable
10 cuts of 16" diameter in 4 minutes. Model "D" Size O, Weight 48 lbs. for cuts up to 20" diameter.
Price $255.00 f. o. b. Denver
with 3 hp 60 cy. 110-120 A. C. 2 hp Ball Bearing Motor.
VULCAN IRON WORKS CO. 1423 STOUT ST. DENVER, COLO.

"ACME" ROAD MACHINERY
Heavy Duty—Larger Capacity—Longer Life—
Try a new Acme Reduction Crusher or a new Acme H. D. Roller Screen on your new job.
Guaranteed rebuilt or used equipment available on attractive lease or sales contract.
For Satisfaction and Service use Genuine **"ACME"** Parts. Communicate with nearest Dealer, main office—
Frankfort, N. Y. or 120 Liberty St., New York City.

HYDRAUGER
MODERN HORIZONTAL BORING MACHINE
For Underground Installation of Pipe and Conduits. Avoids damage to costly pavements and saves time.
Send for Bulletin.
HYDRAUGER CORPORATION, LTD.
116 New Montgomery St. • San Francisco, California



3-Dimension sketches in plant or field —
WADE'S ISOMETRIC
In pads 4x6⅛—100; 8½x11—50; or 11x17—24 sheets with directions—$1.00. At office and drawing supply dealers or:—
WADE INSTRUMENT CO.
Box 2274-C. Cleveland, Ohio

CONSTRUCTION METHODS ADVERTISERS IN THIS ISSUE

Acme Road Mchy. Co. 98
Alemite Div., Stewart Warner Co. 74
Allis-Chalmers Mfg. Co. .... Center Spread
American Brattice Cloth Co. 92
American Cable Co. ..... 3rd Cover
American Hoist & Derrick Co. 17
Ames Baldwin Wyoming Co. 84
Armco Culvert Mfrs. Assn. 81
Athey Truss Wheel Co. 77
Atlas Powder Co. 26
Austin Western Road Mchry. Co. 18-19-83

Baker Mfg. Co. 82
Barber-Greene Co. 87
Barrett Company 31
Bay City Shovels, Inc. 78
Blaw-Knox Company 80
Bucyrus-Erie Co. 22

Caterpillar Tractor Co. 23
Chain Belt Co. 28
Cleveland Tractor Co. ..... 4th Cover
Clyde Sales Co. 86
Complete Mchry. & Equip. Co., Inc. .. 88
Continental Roll & Steel Fdry. Co. 93

Dobbie Fdry. & Mach. Co. 88

Ensign-Bickford Co. 14
Euclid Road Mchry. Co. 6-7

Firestone Tire & Rubber Co. 8-9
Flexible Road Joint Machine Co. 80
Fulton Bag & Cotton Mills 98

Galion Iron Works & Mfg. Co. 79
Goodall Rubber Co. 90
Good Roads Mchry. Co. 90
Gorman-Rupp Co. 88
Greene, Tweed & Co. 86
Gulf Refining Co. 21

Harnischfeger Corp. 73
Hazard Wire Rope Co. 30
Hetherington & Berner, Inc. 92
Hobart Brothers Co. 98
Hug Company 16
Hydrauger Corp., Ltd. 98

Inland Steel Co. 20
Insley Manufacturing Co. 97
International Cement Corp. 5

Jaeger Machine Company 15

Koehring Company 10-11

L & M Mfg. Company 98
La Bour Company 86
Le Tourneau Inc., R. G. 89
Link-Belt Company 24

McGraw-Hill Book Co. 82
Michigan Power Shovel Co. 96
Moretrench Corp. 84

Northwest Engrg. Co. 29
Novo Engine Co. 91

Osgood Company 95

Portland Cement Assn. 85

Roebling's Sons Co., J. A. 76
Rogers Bros. Corp. 98

Schramm, Inc. 75
Service Section 98
Sika, Inc. 90
Sterling Machinery Corp. 92
Stewart Warner Co.—Alemite Div. 74

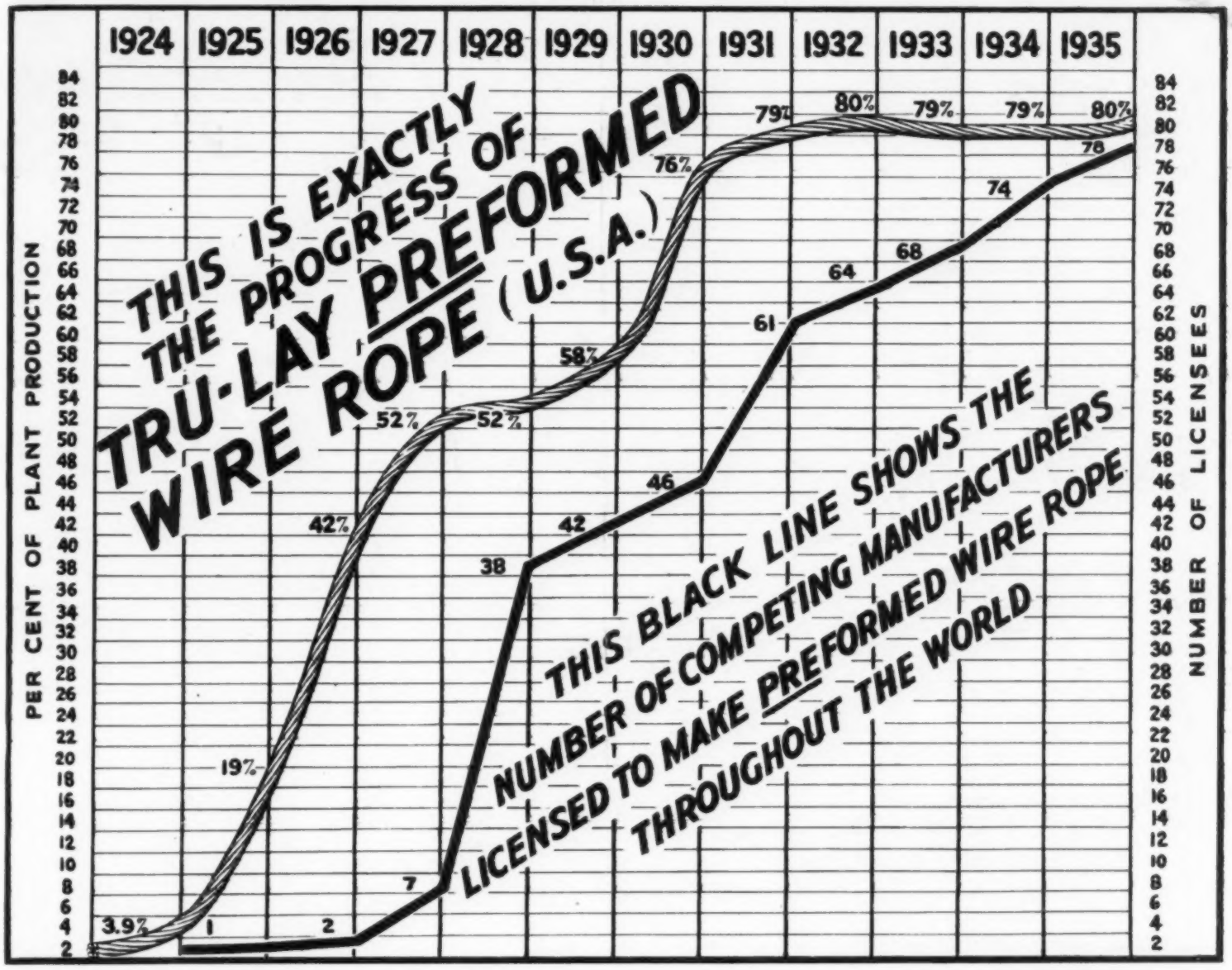
Texas Company 2nd Cover-27
Thew Shovel Co. 12-13

U. S. Steel Corp. Subsidiary 32
Universal Atlas Cement Co. 32
Universal Crane Co. 12-13

Vulcan Iron Wks. Co. 98

Wade Instrument Co. 98
Wickwire Spencer Steel Co. 25

WE WELCOME 1936



● We started making TRU-LAY Preformed Wire Rope in 1924. It was a better rope than had ever been made before. But we had to meet the competition of fixed buying habits; long established standards for wire rope service; the inborn prejudice against anything radically new.

But TRU-LAY Preformed proved itself such a superior rope that today the manufacturers responsible for over 95% of the wire rope production in the United States are licensees under our exclusive preforming patents. They too, *now,* make and sell preformed wire rope. And *that* is new competition for us. Tougher competition. By licensing them we have admitted our keenest competition to our own exclusive field of action.

But we are glad for this new, and tougher, competition. *First:* it is the most convincing acknowledgment of the superiority of preformed wire rope. *Second:* it adds momentum to the swing toward preformed. *Third:* it keeps us on our toes to see that production and service are maintained at the highest standard on our own TRU-LAY Preformed. . . . For—with this new and licensed competition, we've *got* to make TRU-LAY Preformed the best rope of all.

We welcome 1936 . . . the year in which we will prove our "metal" to wire rope users—the quality of our product and the efficiency of our Engineering and Production Departments which the entire industry throughout the world has acknowledged.

AMERICAN CABLE COMPANY, Inc., WILKES-BARRE, PA.

An Associate Company of American Chain Co., Inc.

In Business for Your Safety

Branches or Distributors in all Principal Cities

TRU·LAY *Preformed* Wire Rope

★ ALL AMERICAN CABLE COMPANY ROPES MADE OF IMPROVED PLOW STEEL ARE IDENTIFIED BY THE EMERALD STRAND

Earth Moving Demand Cletrac Power and Spee

120 cubic yards per HOUR

● When the Baltimore & Ohio Railroad was building into Ohio 82 years ago, it would have taken several hundred laborers, with pick and shovel, to move as much earth in a day as a Cletrac 80 Diesel and two or three men move in an hour or two.

On the Cable Company's relocation job at Beach City, Ohio, it required only two Cletrac 80 Diesels to service a 1½ yd. shovel, hauling two 8-yd. wagons and averaging 120 cu. yds. of pay dirt per hour.

On all earth moving jobs, Cletrac power the most profitable you can use. It is usab power at all times—convertible into fas loading and hauling speeds, and into tim saving, quicker turns, because of Cletr controlled, differential steering whi gives power on both tracks at all time an exclusive feature of Cletrac.

Look into Cletrac performance on ear moving jobs—and when you figure, figu on Cletrac. You will make more money the job.

THE CLEVELAND TRACTOR CO.
CLEVELAND, OHIO

Cletrac
Crawler Tractors
Built To Endure
REG. U.S. PAT. OFF.